PHILIPS

RO 325/2

5MHz Mini-Oscilloscopes

Single-trace PM3000
Dual-trace PM3010

(PM 9398 a.c. power supply)

9499 440 13611

7403/1/01

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equipment for science and industry

5MHz Mini-Oscilloscopes
Single-trace PM3000
Dual-trace PM3010

The black paper washers (outer dia 18 mm) which are located under the INTENS and FOCUS knobs, are available under ordering code 5322 532 54382.

PHILIPS

Service manual

5 MHz Mini-Oscilloscopes

Single-trace PM3000

Dual-trace PM3010

(PM9398 a.c. power supply)

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This Service Manual is only issued in the english language

7403/1/01

IMPORTANT

In correspondence concerning this instruments please quote the type number and the serial number as given on the type plate at the rear of the instruments.

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1. General

The Mini-Oscilloscopes PM 3000 (single trace) and PM 3010 (dual trace) feature vertical bandwidth from d.c. up to 5 MHz.

According to their low weight, the instruments are really-portable and may even by carried in an attache-case.
The instruments can be powered by a mains power supply (PM 9398) which is a standard accessory.
The instruments can also be powered by a lead-acid battery (PM 9397) which can be recharged with the above-mentioned mains power supply.
Both the mains power supply and the lead-acid battery have same external dimensions.

2. Specification

Designation	*Specification*	*Additional information*
2.1. C.R.T.		
Type	40DB31	Medium persistence phosphor
Display area	4 x 6 divisions	1 div. = 4,5 mm A removable magnifying lens enlarges the display by more than 1,3 times.
Graticule	Internal	Not illuminated
Acceleration voltage	1,5 kV	
2.2. Y-DEFLECTION		
2.2.1. Response		
Frequency range	d.c. ... 5 MHz	d.c. coupled, –3 dB
	5 Hz ... 5 MHz (PM 3000) 20 Hz ... 5 MHz (PM 3010)	a.c. coupled, –3 dB
Rise time	70 ns	
2.2.2. Deflection coefficients		
PM 3000	10 mV/div ... 5 V/div	Nine positions in 1-2-5 sequence
PM 3010	30 mV/div ... 1 V/div	Four positions in 1-3-10 sequence
Error limit	±5 %	
Overshoot	less than 5 %	
Instability of spotposition	less than 0,5 div.	
Vertical position range	at least 3 times of rated deflection	
2.2.3. Maximum permissible input voltage	±600 V	d.c. + a.c. peak
2.2.4. Input impedance	PM 3000 1 Mohm//30 pF PM 3010 1 Mohm//35 pF	
2.2.5. Display mode (PM 3010 only)		
Channel A and B display	Chopped, if TIME/DIV. switch in position 100 ms ... 3 ms. (chopper frequency 100 kHz). Alternated, if TIME/DIV. switch in position 1 ms ... 1 µs	
2.3. TIME BASE		
2.3.1. Time coefficients		
PM 3000	100 ms/div ... 0,3 µs/div	Twelve positions in 1-3-10 sequence
PM 3010	100 ms/div ... 1 µs/div	Eleven positions in 1-3-10 sequence
Coefficient error	±5 % ±10 %	For positions 100 ms ... 30 ms.

2.3.2. Magnifier (PM 3010 only)

Magnification	10x	Highest effective sweep speed is 0,3 µs/div
Additional error	±5 %	

2.4. TRIGGERING

2.4.1. Trigger mode	Automatic or manual level control	
2.4.2. Trigger source		
PM 3000	Internal External	
PM 3010	Internal External	Channel Y_A or channel Y_B
2.4.3. Trigger sensitivity	Internal 0,5 div. External 0,5 V	
2.4.4. Trigger bandwidth	30 Hz ... 5 MHz 100 Hz ... 5 MHz 30 Hz ... 5 MHz	Internal Automatic External
2.4.5. Input impedance	1 Mohm//50 pF	
2.4.6. Maximum permissible input voltage	±100 V	d.c. + a.c. peak

2.5. OPERATING INSTRUCTIONS

2.5.1. Supply

Mains supply	115 V or 230 V ±10 %; 46 ... 400 Hz Power consumption less than 10 VA	Using PM 9398 At delivery the a.c. power supply is connected for 230 V mains; refer also to para 3.3.
Battery supply	5,4 ... 7 V Current drain less than 0,5 A	Using PM 9397 which provides up to five hours of continuous operation.
2.5.2. Ambient temperature	+5 °C ... +40 °C −10 °C ... +55 °C −40 °C ... +70 °C	Rated range of use Limit range of operation Storage and transport conditions
2.5.3. Operating position	Any	

2.6. ENVIRONMENTAL CAPABILITIES

2.6.1. Vibration	30 minutes along each of the 3 major axes, 0,7 mm displacement with acceleration limit at 5 g, cycling from 10 ... 150 ... 10 Hz at 1 octave/minute.	Reference IEC 68, test Fc.
2.6.2. Bumptest	1000 bumps along each of the 3 major axes, acceleration 10 g.	Reference IEC 68, test Eb.
2.6.3. Bench handling	Drop with one edge lifted 5 cm from the floor; 3 drops per edge.	

2.7. MECHANICAL DATA

2.7.1. Dimensions

Depth 196 mm
Width 125 mm
Height 81 mm

2.7.2. Weight

1,8 kg loaded with battery PM 9397
1,6 kg loaded with a.c. power supply PM 9398

2.8. SAFETY CLASS

The PM 9398 AC power supply/battery charger fulfils the safety requirements of IEC 348 for class II instruments.

2.9. ACCESSORIES

2.9.1. Standard accessories delivered with the instrument

- Magnifying lens, enlarging the display by more than 1,3 times.
- A.C. Power supply PM 9398 which fits both PM 3000 and PM 3010.
- Carrying case.
- Operating manual.
- Connecting material

2.9.2. Optional accessories

- Rechargeable sealed lead-acid battery PM 9397.
  The battery supplies 6 V/3 Ah and provides up to 5 hours of continuous operation.
- Passive probe set PM 9326 with a 10:1 and a 1:1 probe; cable length 1,15 m.
- Passive 1:1 probe PM 9335.
- Passive 10:1 probe PM 9336; cable length 1,5 m.
- Passive 10:1 probe PM 9336L; cable length 2,5 m.

3. Concise operating instructions

3.1. USE OF THE A.C. POWER SUPPLY UNIT AND THE BATTERY

3.1.1. A.C. Power supply loading procedure

- Remove the rear panel by rotating the screw (use a coin).
- Snap on the button terminal strip which is found in the supply compartment.
- Put the a.c. power supply into the compartment of the oscilloscope with the terminal strip facing the front of the set. Check the position with respect to the mains cord outlet
- Replace the rear panel taking the mains cord through the hole in the panel.
- Tighten the screw in the rear panel.

3.1.2. Battery loading procedure

This procedure is the same as above.
The hole in the rear panel can be closed by the relevant hole cover.

3.1.3. Recharging the battery

3.1.3.1. General

The need for recharging of the battery is indicated by the pilot lamp (POWER) of the oscilloscope.
When this lamp extinguishes during operation, the battery must be recharged immediately. When the battery is used after the pilot lamp has extinguished, it will be irretrievably damaged.
The battery must be recharged by the a.c. power supply PM 9398 only.
As this unit has been designed especially for operation of the miniature oscilloscopes and for recharging battery PM 9397, it is not recommended to use it for the charging of other battery types.
Note that the a.c. power supply is provided with a push-switch (located between the terminals).
If this unit is used as a power supply for the oscilloscope this switch is not activated (the pilot lamp on the unit is not lighting).
If used as a battery-charger the switch is pushed-in by the small block between the terminals of the battery (the pilot lamp on the unit is now lighting).
By pushing the switch the polarity of the output voltage is reversed, and the unit is switched-over for joggle charging.
The a.c. power supply unit is provided with a 1A-fuse, which is located inside this unit.

3.1.3.2. Recharging procedure

- Connect the battery to the a.c. power supply. Make sure that the switch on the a.c. power supply is actuated by the battery. During charging, keep both units on a level surface to prevent springing loose of the button terminals.
  Connecting the battery to the a.c. power supply unit, before connecting the unit to the mains is necessary in order to prevent uncontrolled high switching currents.
- Connect the mains cord to the mains and check that the pilot lamp on the a.c. power supply lights up.
- Recharging has been completed when the pilot lamp starts blinking.
- The ambient temperature for recharging should be 0^{o} ... 40 ^{o}C.

3.1.4. Precautions to be taken when using, charging and storing battery PM 9397

- The battery has been designed to match the characteristics of the miniature oscilloscopes PM 3000 and PM 3010.
  Therefore, it should not be used to power other electrical instruments or appliances.
- Only use the a.c. power supply PM 9398 to charge the battery, as its circuitry has been designed to match the battery characteristics. If a different type of battery charger is used, the battery may be over- or under-charged and its life drastically shortened.
  With the PM 9398 the battery cannot be overcharged.
- Make a habit of recharging the battery immediately after use. The best way to keep the battery in tip-top condition is to keep it fully charged.
- Do not leave the oscilloscope switched-on overnight if it is powered by the battery. The battery discharges in approximately 5 hours of continuous use of a safe level. If this level is exceeded by discharging the battery further, it will be over-discharged and damaged beyond repair.

- Store the battery preferably at an ambient temperature between −15 °C and +20 °C. At a higher temperature, the chemical reaction in the electrolyte and thus the self-discharging is accelerated.
- During extended storage, occasional charging of the battery is necessary. To avoid over-discharge during storage, we recommend to charge stored batteries once every three months.
- Do not short-circuit the battery terminals. This causes a current of over 100 A to flow and the terminals will be severely burned.
  Recently charged batteries may even explode due to the oxygen and hydrogen produced in the charging proces.
- If the battery case is broken, hand and clothes may come into contact with the electrolyte. The best neutralizing agent for the electrolyte is sodium carbonate (Na_2CO_3). If the latter is not available, the hands and clothes must be thorougly washed with water and soap.
- Never use paraffin oil or thinner to clean the battery case. Always use a soft cloth dampened with denatured alcohol or water. Afterwards wipe the case with a dry cloth.

3.2. EARTHING

Make sure that the instrument-cabinet is properly earthed.
The measuring-earth terminal at the front of the instrument is connected to the cabinet.

IMPORTANT *Neither battery supply, nor supply with the double-insulated a.c. power unit PM 9398 make the instrument safe for floating measurements, since the measuring earth is connected to the metal cabinet.*

3.3. ADAPTING TO THE LOCAL MAINS VOLTAGE

The primary of the mains transformer of the a.c. power supply unit consists of two windings which are connected in series for mains voltages of 207 ... 253 V, and in parallel for mains voltages of 104 ... 126 V. At delivery the a.c. power supply unit is set for a mains voltage of 230 V (nominal). See Fig. 3.1.

To adapt the supply to a 115 V mains, proceed as follows:
- Remove the lid of the a.c. power supply (2 screws)
- Remove the connection wire between B and C
- Interconnect points A and C
- Interconnect points B and D
- Refit the lid

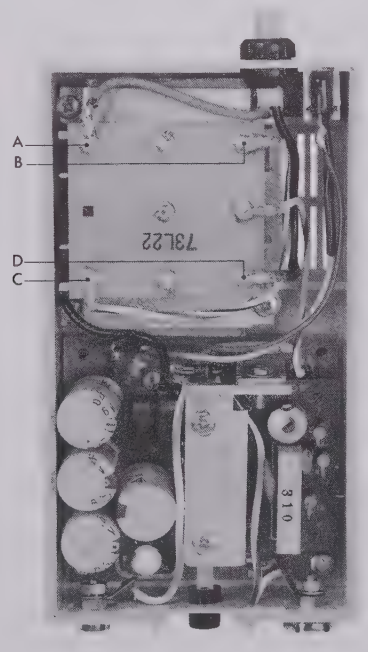


Fig. 3.1. Primary connections mains transformer and secundary fuse

3.4. PRELIMINARY SETTINGS

– Switch on the instrument.
– AC/0/DC switch(es) to AC.
– POSITION controls to mid-range.
– TIME/DIV control to 1 ms.
– LEVEL control to AUTO (depressed).
– INT/EXT switch to INT.
– INTENS control fully clockwise.
– FOCUS control to mid-range.

Extra for PM 3010:
– TRIG switch to Y_A
– TB MAIN control to x1

NOTE: Controls not mentioned may be in any position.

The time-base line(s) should appear after approx. 10 s.
When the display is there, adjust INTENS and FOCUS for a sharp, well-defined display.

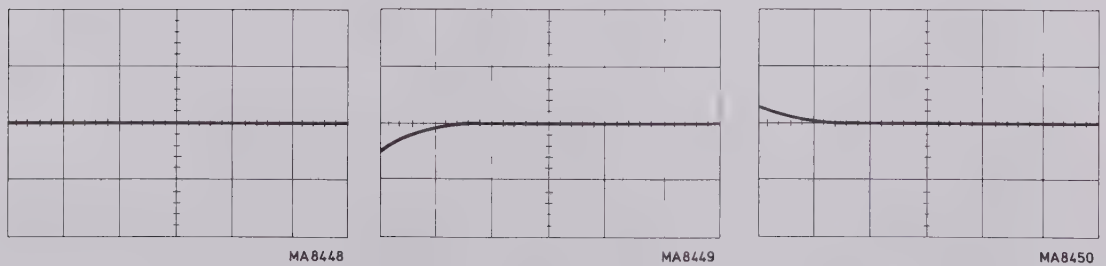
– Centre the trace(s).
– Check that the trace runs exactly in parallel with the horizontal lines of the graticule.
If necessary, adjust the TRACE ROTATION control which is a screwdriver operated potentiometer, accessible through a hole in the righthand side panel of the oscilloscope.

The oscilloscope is then ready for use.

3.5. PROBE COMPENSATION

If an attenuator probe is used with the oscilloscope, this probe must match the input resistance and -capacitance of the oscilloscope.
In general the input resistance of oscilloscopes is standardized to 1 MΩ.
As the input capacitance can be different for various types of oscilloscopes, adjustment of the attenuator probe may be necessary.
The probe comp. calibration voltage is available at the PROBE COMP. outlet at the rear panel of the oscilloscope.
This voltage is a sharp-edge negative-block signal derived from the time base gating circuit.

– Y input switch(es) to DC
– V/DIV switch(es) to 30 mV
– TIME/DIV switch to 30 μs
– Adjust the trimmer capacitor of the probe until a straight line is obtained. See Fig. 3.2.



Correct *Undercompensation* *Overcompensation*

Fig. 3.2. Probe compensation

4. Circuit description

As the basic principles of both oscilloscopes are the same, the circuits of both sets are described in one chapter.
The circuit is divided into the following units:
1. Y-attenuator(s)
2. Y-amplifier
3. Trigger, time-base and X-amplifier
4. Supply part and c.r.t. circuit

The Y-attenuators and Y-amplifiers are different for both sets.
The trigger, time-base and X-amplifier differ in some details only.
The supply part and the c.r.t. circuit are the same for both sets.

4.1. Y-DEFLECTION

4.1.1. Input attenuator

PM 3000

The input attenuator switch S102 has 9 positions internally divided in three groups having an attenuation of 1, 10 and 100 respectively.
In each group are three switch positions which control the gain of the Y-amplifier (factor 1, 2 or 5).
The input capacitance of the oscilloscope is kept constant with trimmers C11 and C14. The capacitive voltage divider is pre-adjusted with trimmers C12 and C15 for optimum square wave response.

PM 3010

Both attenuators are identical.
The attenuator switches (S102 and S122) are four-position slide switches.
The input capacitance is kept constant for different attenuators-switch positions with trimmers C11, C15, C18 and C21, C25, C28.
The capacitive voltage divider is adjusted for optimum square-wave response with trimmers C12, C14, C17 and C22, C24, C27.

4.1.2. Amplifier

4.1.2.1. PM 3000

The signal from the attenuator is applied to input transistor Q101A. Together with transistor Q101B a balanced signal is obtained.
To compensate for thermal drift effect, for Q101A and Q101B a dual transistor in one envelope has been chosen.
The gate of transistor Q101A (being a f.e.t.) is protected against over-voltage with diodes D101 and D102.
To suppres vertical movement of the trace when the attenuator switch is operated, the balance of the amplifier can be adjusted with potentiometer R104.
Via emittor-followers Q102 and Q103 the signal is applied to transistors Q104 and Q105. With attenuator switch S102, different resistors are chosen between the emittors of Q104 and Q105 in order to obtain different gain factors of the amplifier.
Further on the signal is amplified by transistors Q106, Q107 and the final stage Q108, Q109.
The Y-deflection plates of the c.r.t. are connected direct to the collectors of Q108, Q109.
Potentiometer R109, between the bases of Q106 and Q107, allows vertical position control of the trace.
C107 is a correction trimmer for adjusting correct 100 kHz response.
The internal trigger signal is taken off at R127/R128 and applied to the input selection switch of the trigger circuit.
C147 (0,7 pF) compensates for capacitance-unbalance of the Y-deflection plates.

4.1.2.2. PM 3010

The signal from the attenuator is applied to the input transistor Q101A (Q121A)*.
Together with transistors Q101B (Q121B) a balanced signal is obtained.
To compensate for thermal drift effects, for Q101A and Q101B (Q121A, Q121B) a dual transistor in one envelop has been chosen.
The gate of transistor Q101A (Q121A) is protected against negative over-voltage with diode D102 (D122).
For positive over-voltages the gate is conductive and the current is limited by R102 (R122) and the series resistor in the attenuator.
Via emittor-followers Q102 and Q103 (Q122 and Q123) the signal is applied to transistors Q104 and Q105 (Q124 and Q125), and to the input of operational amplifier IC101 (IC121) which acts as a trigger pre-amplifier.
The gain of Q104, Q105 (Q124, 125) can be pre-adjusted with R121 (R171); h.f. response is adjustable with C115 (C135).
The output of operational amplifier IC101 (IC121) is connected to the trigger selector switch (refer to para 4.2.1.).
The gain of the operational amplifier is set to approx. 20 with R116 (R166).

4.1.3. Electronic switch (PM 3010 only)

To display both YA and YB signals simultaneously, the signals present on the collectors of Q104, 105 and Q124, 125 are selected with the aid of an electronic switch consisting of eight diodes (IC102).
To compensate for capacity differences in the electronic switch, the 2 pF capacitors C136 and C137 have been connected between the inputs of the electronic switch. The electronic switch is controlled by a multivibrator consisting of transistors Q131 and Q132 (refer to para 4.1.5.).
The output signal of the electronic switch is applied to transistors Q106 and Q107 of the final Y-amplifier.

4.1.4. Final amplifier (PM 3010 only)

This amplifier consists of three stages with transistors Q106, 107, Q108, 109 and Q110, 111. Frequency response is adjustable with trimmer C144.
The collectors of Q110 and Q111 are connected direct to the Y-deflection plates of the c.r.t.
C147 (0,7 pF) compensates for capacitance-unbalance of the Y-deflection plates.

4.1.5. Electronic switch control circuit (PM 3010 only)

The electronic switch is controlled by the voltage at the collectors of transistors Q131 and Q132, which form a bi-stable multivibrator.
As set/reset pulse for this multivibrator, a signal is used which is generated by a blocking oscillator, formed by transistor Q134 and transformer T101. The function of this circuit depends on the position of the TIME/DIV switch S204.
For sweep times of 100 ms ... 3 ms/div this circuit is free running at 200 kHz. Via D131 this signal is applied to Q131, Q132 so that a chopped display is obtained (chopper frequency 100 kHz).
During switching-over of the chopper, the c.r.t. electron beam is blanked to improve display quality. This is effected by transistor Q133 which is coupled to the unblanking circuit via D132.
In the remaining positions of the TIME/DIV switch, transistor Q134 is driven by the output voltage of the sweep-gating multivibrator of the time base circuit. The multivibrator Q131, Q132 is then controlled in such a way that traces YA and YB are written alternatively.

4.2. TRIGGER, TIME-BASE, UNBLANKING AND X-AMPLIFIER

These circuits are nearly the same for both sets.

4.2.1. Trigger circuit

The trigger input signal, selected by switch S201, is applied to the gate of f.e.t. Q201. In the PM 3000, S201 has two positions: INT. and EXT. In the PM 3010 this switch has three positions: YA, YB and EXT. The output signal of Q201 is fed to one section of the +/— slope switch S202, the other section of which is connected to a d.c. voltage, that can be adjusted with the LEVEL control potentiometer R209.

* Item numbers in brackets apply to channel B.

At the collector of transistor B a signal is present which depends on: the trigger signal, the position of switch S202 and potentiometer R209.
This signal is shaped to a sharp-edge square-wave signal by the trigger pulse shaper consisting of transistors C and D. Next, the signal is fed to transistor Q202 and to the auto-circuit (transistor E).
The signal on the base of Q202 is differentiated by C205. As a result of this, sharp negative pulses are present on the collector of Q202, which are applied to sweep gating multivibrator Q203, Q204, via C206. The function of this multivibrator (which has two stable conditions) is to control transistor Q205 which is part of the time-base sweep circuit.
Besides by the trigger pulses, the sweep gating multivibrator is also controlled by the voltages from hold-off and auto-circuit.

4.2.2. Time-base

The time-base sweep voltage is generated by charging one of the capacitors C221 to C227 via the constant current source Q207.
The required time-base capacitor and the appertaining constant current are determined by the position of TIME/div switch S204.
Transistor Q205, in parallel to the time-base capacitor, is controlled by sweep gating multivibrator Q203, Q204. During the sweep time Q205 is blocked so that the time-base capacitor is charged.
At the end of the sweep time the sweep gating multivibrator Q203, Q204 is reset by the voltage applied via Q206 and emittor follower Q209. As a result of this, Q205 becomes conductive and the time-base capacitor is quickly discharged.
C212 is the hold-off capacitor; in the PM 3000 C217 is switched in parallel to obtain longer hold-off times at sweep times of 3 ms and longer. Q208 is used to detect discharge current of the timing capacitance and produce hold-off timing.
With the aid of the auto-circuit (transistor E), a free running display can be obtained if the time-base circuit is not triggered in position AUTO of S203.
S203 is the push-pull switch coupled with the LEVEL control potentiometer on the front panel.
In position AUTO of S203, the voltage on the emittor of transistor E depends on the presence of trigger pulses. If no trigger pulses are present, the emittor-voltage of transistor E has such a value that the sweep gating multivibrator Q203, Q204 is free running, only controlled by the hold-off voltage.
If trigger pulses are present the voltage on the emittor of transistor E becomes less negative (by the rectifying effect of C208 and D201, D202).
The sweep gating multivibrator is now controlled by the trigger pulses coming from C206; the hold-off voltage too, of course, controls the sweep gating multivibrator.
In position NORMAL of S203 (knob LEVEL pulled out) the emitter voltage of transistor E remains at a constant value depending on the position of R236.
The sweep gating multivibrator is now controlled by trigger pulses and hold-off voltage. If no trigger pulses are present the sweep gating multivibrator is kept stable and no sweep is iniated.
The voltage on the collector of Q204 of the sweep gating multivibrator is also used as a:
a. Calibration signal to adjust a test probe
b. Voltage to drive the unblanking circuit
c. Signal to drive the electronic switch control circuit (PM 3010 only)

4.2.3. Unblanking circuit

This circuit consists of transistors Q214 ... Q216. The unblanking pulse is, via emittor follower Q214, applied to amplifier Q215 which also inverts the signal. Via emittor follower Q216 the unblanking signal is applied to the Wehnelt cylinder circuit of the cathode ray tube.
In the PM 3010, if the TIME/div. switch is in position DETECT, the emitter of Q215 is kept at a constant positive voltage level via R288.
Because then Q215 is blocked, the intensity of the display (spot) is no longer modulated.

4.2.4. X-Amplifier

The sweep voltage across the time-base capacitor is applied to transistor Q218, via f.e.t. Q206. The collector of Q218 is connected to the base of transistor Q212 of the final stage.
The display can be shifted in X direction by X POSITION potentiometer R266 which controls transistor Q217.
Gain of the final stage is adjustable with R270; frequency compensation is possible with C234.

In the PM 3010 the gain of the X amplifier can be increased with the x10 switch S205.
In this case the resistance between the emittors of Q217 and Q218 is decreased by the parallel switching of R264a, b. In the x10 position of S205 the gain is adjustable with R264b.
Furthermore, if in the PM 3010 the TIME/div. switch S204 is in the DETECT position, contact 10 of S204 between the base of Q218 and earth is closed so that no X deflection takes place (a spot is displayed).

4.2.5. Detect (PM 3010 only)

When the time-base switch occupies the DETECT position, the X-amplifier is no longer driven (S204/10 is closed).
When the LEVEL-knob is pulled (Normal mode) and no trigger pulses are applied only one dot is displayed (of either the A or B channel).
Because of the time-base is in the alternate mode, a trigger pulse will reset the electronic switch, so that the dot disappears and the dot of the other channel becomes visible (assumed that not both dots coincide by the same Y-position adjustment).
Refer also to para 4.1.5.

4.3. SUPPLY PART AND C.R.T. CIRCUIT

These circuits are the same for both sets, refer to Fig. 9-11.

4.3.1. Supply part

This consists of following main circuits:
a. Supply voltage regulator
b. Converter circuit

Supply voltage regulator

The 6 V supply voltage from either the AC power supply PM 9398 or the battery PM 9399 is passed via POWER switch S301 and the r.f. choke L301 to the regulating transistor Q301.
Q301 is controlled by Q302 and Q303. The base of Q303 is kept at a constant voltage level by diodes D301A and B biased in forward direction.
The output voltage at the emittor of Q301 (4,5 V) can be adjusted with R305.
Light emitting diode D300 is connected to the power input voltage, via R308 and 4 V Z-diode D309.

Converter circuit

Transistors Q304 and Q305 and transformer T301 form a chopper oscillator.
The base current of the chopper transistors is limited by D302, R310 and C302.
C303 and R307 ensure starting of the chopper oscillator at the moment of switching-on.
At the secundary windings of T301 several voltages are taken off and rectified.
The rectifiers for the high-voltage of the c.r.t. are voltage multiplying rectifiers. The diodes of these rectifiers are encapsulated in groups of four.

4.3.2. C.R.T. circuit

The voltages for cathode and focus electrode are taken from rectifiers IC303 and IC304.
The voltage for the Wehnelt cylinder of the c.r.t. is supplied by the rectifiers IC301 and IC302. The positive side of this rectifier is connected to earth via R283 of the unblanking circuit. The trace rotation coil enables the alignment of the X trace with the X lines of the graticule of the c.r.t.
The coil is supplied with the stabilized d.c. voltage of the voltage regulator via the double potentiometer R319a.

5. Dismantling

General (see Fig. 5.1.)

The rear panel of the set can be removed, by loosening the central screw (A) in this panel, using a coin. The a.c. power supply or battery can now be removed from the oscilloscope.

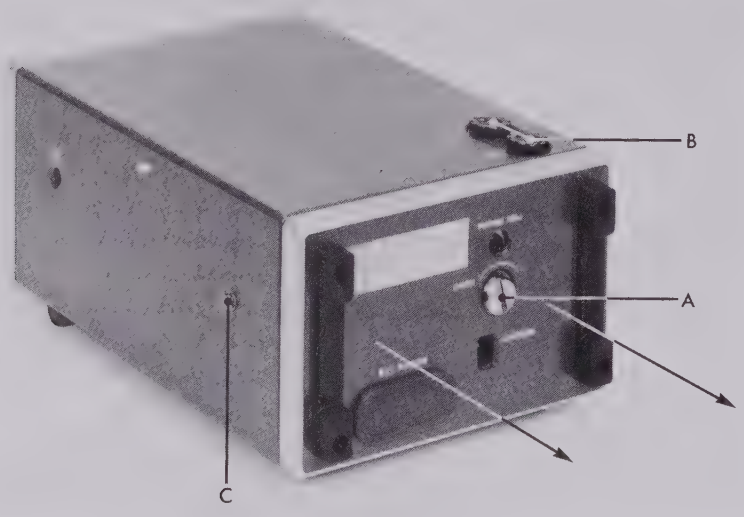


Fig. 5.1. Dismantling

Acces to the parts inside the oscilloscope is gained after removing both the INTENS and FOCUS knobs (B) (black part of the knobs only) and removing the screw (C) in the right-hand side panel. The cabinet can then be slid of the frame. Use the correct size cross-head screwdriver to avoid damage of the small screws.
The knobs on the front panel can be removed after removing the knob cap and loosening the clamp screw in the knob.

Printed-circuit boards

Remove the rear panel and the cabinet (see above).
By removing the four screws on each corner of the p.c. boards, these panels can be lifted out to gain access to the components.
The power supply and h.v. circuit board can be reached after removing the relevant screening.
This circuit board is provided with a p.c. connector and can be removed after loosening two screws.

Cathode ray tube

Remove the rear panel and the cabinet (see above).
Remove the magnifying lens (slide upwards), see Fig. 5.2.
Remove the c.r.t. bezel (to this end press lightly on the long sides and pull outwards), see Fig. 5.3.
Remove the screws (D) of the clamping bracket of the c.r.t., see Fig. 5.4.
After removal of the c.r.t. socket, the c.r.t. can be taken out through the front panel.

Fig. 5.2. Removing the lens

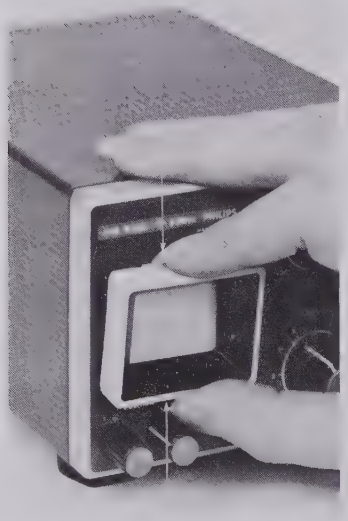


Fig. 5.3. Removing the c.r.t. bezel

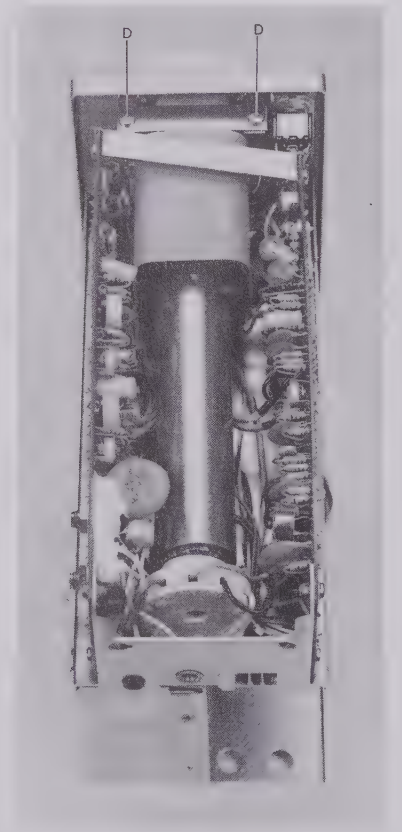


Fig. 5.4. C.r.t. clamping-bracket screws

6. Trouble shooting

For preliminary setting of the knobs refer to chapter 3.2.

6.1. PILOT LAMP DOES NOT LIGHT UP

If the pilot lamp on the front panel of the oscilloscope does not light up, it signifies that the power supply voltage is too low.
When the battery is used as power supply, the extinguished pilot lamp indicates that the battery is over-discharged. The battery must be recharged immediately.
In case the oscilloscope is powered by the a.c. power supply and the pilot lamp on the front panel does not light up, check the voltage on the power input terminals.
In case of doubt a d.c. 6 V power supply unit may be used to supply the oscilloscope. See Fig. 6.1. for terminal polarity.
If the oscilloscope is normal, the pilot lamp lights up and approx. 0,5 amp current is drawn from the power supply.

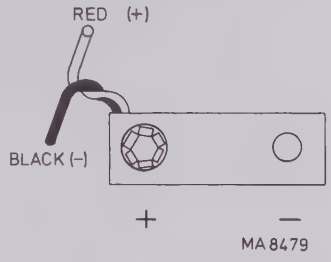


Fig. 6.1. Power supply terminals of the oscilloscope

6.2. PILOT LAMP LIGHTS UP

If the pilot lamp on the front panel of the oscilloscope lights up and a trace does not appear, rotate the INTENS control fully clockwise and depress the LEVEL control for automatic triggering.
Rotate the Y position control and check whether a trace appears. If it does the instrument is normal.
If a trace does not appear, rotate the X position control. A bright dot might appear. If it does, the trouble is in the horizontal deflection system.
If no dot appears, the trouble may be in the power supply, the c.r.t. circuits, the vertical deflection system or the horizontal deflection system.

7. Checking and adjusting

7.1. GENERAL

Following procedure applies to PM 3000 and PM 3010. Only the Y amplifiers are treated separately.
Because some of the circuits are interdependent, this procedure is presented in a certain sequence. If necessary, cross reference is made to any circuit which may influence a particular adjustment. The tolerances stated in this checking and adjusting procedure apply only to instruments which are completely adjusted, and may differ from the data given in Chapter SPECIFICATION of this manual.
Only skilled personnel familiar with the risks of shock should perform those adjustments which necessitate the removal of covers from an oscilloscope which is switched-on.
Check that the a.c. power supply is adapted to the local main voltage. Refer to para 3.3.
In general a preliminary warm-up time of at least 10 minutes is recommended. Because of the small dimensions be careful when using a test probe as short circuits easy occur.

Test conditions.
The waveforms and voltages given in the circuit diagrams are measured with following settings:

TIME/DIV knob to 1 ms

Y Ampl. circuits : AC/0/DC switch to 0
Trace(s) shifted to centre-line

Trigg. time-base and X ampl. circuit: Y input 0,1 V_{tt} square wave
AC/0/DC switch to AC
V/DIV switch to 0.1 V
TRIGG switch INT
SLOPE +
LEVEL centre (0)

Required test equipment

Following equipment is necessary, when an instrument needs complete checking and adjusting, as indicated in this information:

a. Digital Voltmeter
Accuracy: better than ±0,1 %

b. Oscilloscope
Maximum sensitivity: 5 mV/div
Bandwidth : over 18 MHz

c. Constant Amplitude Generator
Sinewave : 30 Hz up to 5 MHz
Output impedance: 50 Ω

d. Square Wave Generator
Frequency : 1 kHz up to 100 kHz
Rise time : less than 10 ns
Output impedance: 50 Ω

e. Time Marker Generator
Time : 0,1 s up to 0,1 μs
Output impedance: 50 Ω

f. Amplitude Calibrator
Output voltage : 10 mV up to 100 V_{p-p}
Output impedance: 50 Ω

g. D.C. Ammeter
Range up to 1 Amp.

h. A.C. Wattmeter
Range up to 24 W

i. D.C. High Voltage Meter
Capable of measuring −1500 V at 1 % accuracy

j. Capacitance meter

7.2. SUPPLY PART

— Check the supply voltages as indicated in Fig. 7.1.

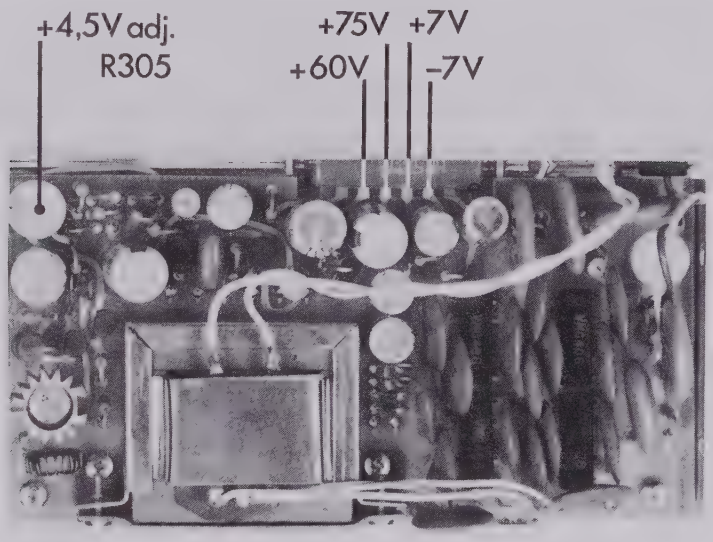


Fig. 7.1. Supply part circuit board

— Check the 4,5 V (+ or −0,5 %) output voltage of the regulator stage (across C304). If necessary adjust R305.

Current drain.
Measure the current via one of the power supply terminals.
The current must be 500 mA (+ or −30 mA) at 6 V supply voltage.

7.3. C.R.T. CIRCUIT

7.3.1. High voltage circuits

The high voltages on the cathode ray tube must be measured with due care.

Voltage on	Measure on point
Cathode : −1470 V	R322/R323
Control grid: −1500 V	R316/R318
Focus grid : −1000 V	Wiper of R321

7.3.2. Deflection circuits

— Set the Y input switch(es) to the 0 position.
— Pull the LEVEL knob for normal sweep mode (the time base is not triggered).

– Connect the digital V meter to the X deflection plates (collectors of Q210 and Q213). See Fig. 7.6.
– Adjust the X POSITION control until the digital V meter indicates 0 Volt.
– Disconnect the negative connector of the V meter from the X deflection plate and connect it to the chassis. The V meter should indicate approximately 50 V.
– TIME/DIV knob to .3 ms (PM 3010 only).
– Connect the digital V meter to the Y deflection plates (collectors of Q108 and Q109 for the PM 3000, or collectors of Q110 and Q111 for the PM 3010). See Fig. 7.2. or 7.5.
– Adjust the Y POSITION control(s) until the digital V meter reads 0 Volt.
– Disconnect the negative connector of the V meter from the deflection plate and connect it to the chassis. The V meter should indicate approximately 34 V.

7.3.3. Intensity

– Push the LEVEL knob for AUTO sweep mode.
– Check that the trace will appear on the c.r.t. screen when the INTENS knob is rotated 90° from the counter-clockwise stop.
– If necessary, adjust R316 INTENS ADJ. . See Fig. 7.6.

7.3.4. Trace rotation

– Push the LEVEL knob for AUTO sweep mode.
– Set the Y input switch(es) to the 0 position.
– Adjust R319a, b, which is accessible through the right-hand side of the cabinet, until the trace runs exactly in parallel with the horizontal lines of the graticule of the c.r.t.

7.3.5. Astigmatism

– Apply a 50 kHz sine-wave signal to the Y input connector.
– Y input switch to AC.
– Set the input voltage or the Y-input V/DIV switch for a vertical deflection of four divisions.
– Adjust TIME/DIV knob and LEVEL knob for a stable display of approximately ten sine-waves.
– Adjust INTENS and FOCUS controls for a well-defined reasonably sharp display.
– If necessary, adjust R325 Astig. Adj. to obtain sharpest focus.

7.4. Y-AMPLIFIER

7.4.1. PM 3000, see Fig. 7.2.

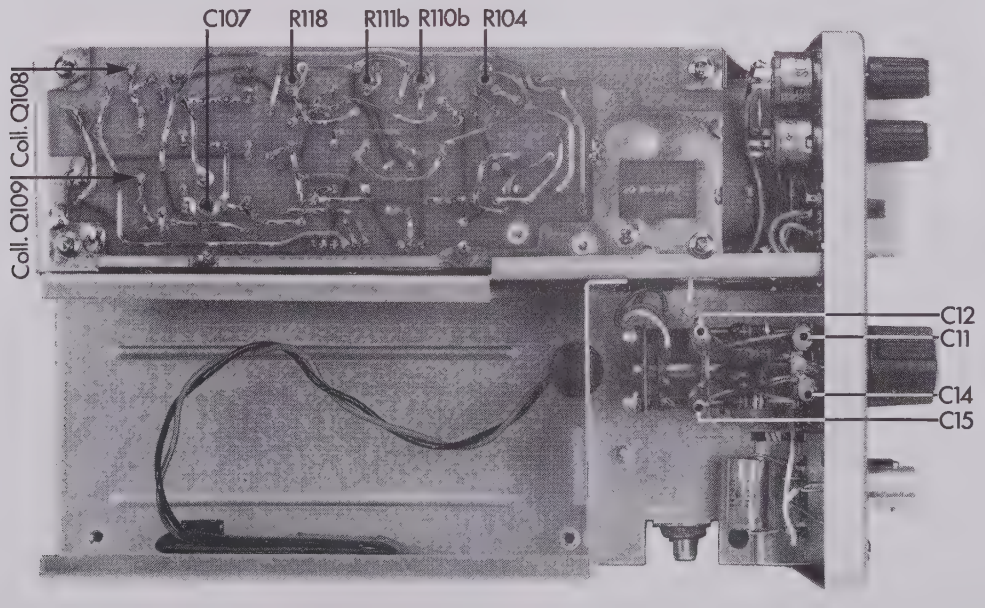


Fig. 7.2. PM 3000 Y-amplifier and attenuator adjustment points

7.4.1.1. Attenuator balance

- Y-input switch to position 0.
- Push the LEVEL knob for AUTO sweep mode.
- Check that the trace does not jump vertically when the attenuator switch AMPL./DIV is rotated. If necessary, adjust R104 Att. Bal.

7.4.1.2. Gain

- Apply an amplitude calibrated 50 ohm, 1 kHz square-wave signal of 0,2 V_{p-p} to the Y-input.
- AMPL/DIV switch to 50 mV.
- The vertical deflection must be 4 divisions. If necessary, adjust R118.
- Change the input signal to 80 mV_{p-p}.
- AMPL/DIV switch to 20 mV.
- The vertical deflection must be 4 divisions. If necessary, adjust R111b.
- Change the input voltage to 40 mV_{p-p}.
- AMPL./DIV switch to 10 mV.
- The vertical deflection must be 4 divisions. If necessary, adjust R110b.

7.4.1.3. Input capacitance

- Connect a capacitance meter to the Y input connector of the oscilloscope.
- AMPL/DIV switch to 10 mV (the oscilloscope must be switched-off)
- The input capacitance must be 30 pF or less.

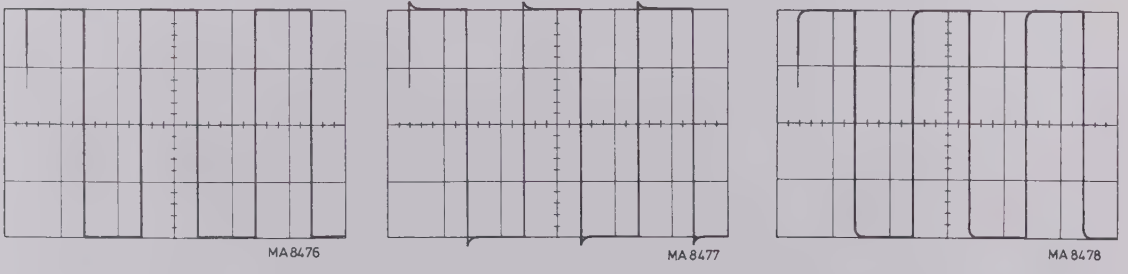
7.4.1.4. Attenuator accuracy

- Apply an adjustable calibrated 1 kHz sine-wave voltage to the Y input connector.
- Change over the AMPL/DIV switch from 10 mV to 5 V position, to confirm that the vertical deflection accuracy is within 5 % in each range.

7.4.1.5. Attenuator response

In this procedure first the capacitance voltage divider of the attenuator is checked; after that a 1:10 measuring probe is calibrated and then the input capacitance of the oscilloscope at different AMPL/DIV switch positions is compensated for.
For location of the trimming capacitors refer to Fig. 7.2.

- Apply a 50 ohm, 1 kHz square wave signal to the Y input connector, via a 50 ohm cable and a 50 ohm cable termination pad.
- In all below-mentioned AMPL/DIV switch positions the amplitude of input signal must be set for a vertical deflection of 4 divisions.
- AMPL/DIV switch to position .5 V.
- The displayed waveform must be undistorted, See Fig. 7.3.1. If necessary, adjust C12.



Correct *Overcompensated* *Undercompensated*

Fig. 7.3. Attenuator response

– AMPL/DIV switch to position 5 V.
– The displayed waveform must be undistorted.
  If necessary, adjust C15.
  Connect an 1:10 probe to the Y input connector.
  Connect the probe-tip direct to the square-wave generator output.
– AMPL/DIV switch to position 10 mV.
– Adjust the probe capacitor to attain an undistorted display.
– AMPL/DIV switch to position .1 V.
– The displayed waveform must be undistorted. If necessary, adjust C11.
– AMPL./DIV switch to position 1 V.
– The displayed waveform must be undistorted.
  If necessary, adjust C14.

7.4.1.6. 100 kHz square-wave response

– Apply a 100 kHz square-wave signal to the Y-input.
– AMPL/DIV switch to 10 mV.
– Set the generator output voltage for a vertical deflection of 4 divisions.
– Possible overshoot should be 2 % at max. If necessary, adjust C107.

7.4.1.7. Upper bandwidth limit

– Connect a 50 ohm, constant amplitude, sine-wave signal generator, via a 50 ohm cable and a 50 ohm cable termination pad to the Y-input connector.
– Input frequency 50 kHz.
– AMPL/DIV switch to 10 mV.
– Set the generator output voltage for a vertical deflection of 4 divisions.
– Change the input frequency to 5 MHz (at constant voltage).
  The variation of the deflection should be 3 dB at max. (the deflection may not be less than 2,8 divisions).

7.4.1.8. Linearity

– Connect a 50 ohm, constant amplitude, sine-wave signal generator, via a 50 ohm cable and a 50 ohm cable termination pad to the Y input connector.
– Input frequency 50 kHz.
– Set the input voltage for a vertical deflection of 2 divisions.
– Move the display up and down with the Y position knob as indicated in Fig. 7.4.

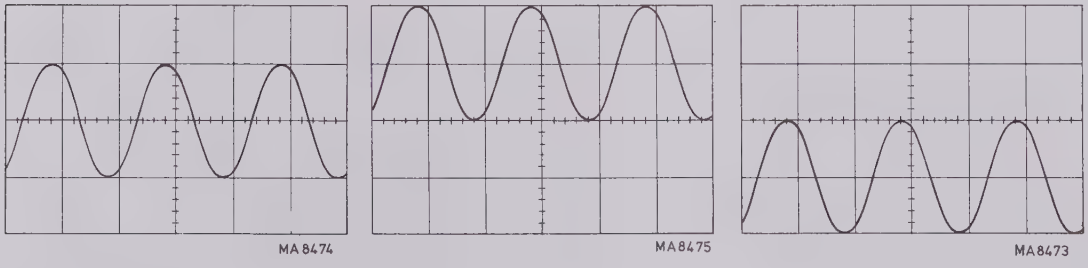


Fig. 7.4. Linearity

– The variation of amplitude of the display (in vertical direction) must be less than 0,1 division.
– Repeat above procedure at 5 MHz.

7.4.2. PM 3010, see Fig. 7.5.

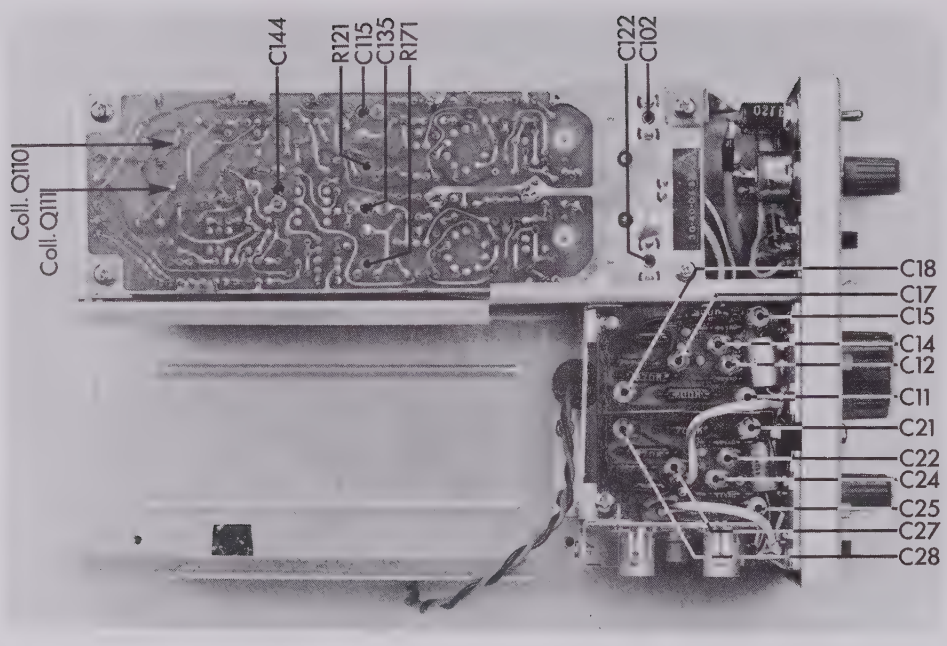


Fig. 7.5. PM 3010 Y-amplifier and attenuator adjustment points

7.4.2.1. Input capacitance

Both Y channels must have the same input capacitance, so that an attenuator probe can be changed from the YA to the YB input and vice versa, without the necessity of recalibrating the probe.
In following procedure first the YA input capacitance is checked; after that a attenuator probe is calibrated on the YA input.
Then the YB input capacitance is adjusted in combination with the calibrated probe.

- Connect a capacitance meter to the YA input connector (the oscilloscope must be switched-off).
- Both V/DIV switches to position .03.
- The input capacitance must be 35 pF.
  If necessary, adjust C102.
- Connect a 1:10 probe to the YA input connector (remove capacitance meter).
- Connect the probe-tip direct to the input of a 1 kHz square-wave generator.
- Switch on the oscilloscope.
- Adjust the output voltage of the generator in order to obtain a vertical deflection of 4 divisions.
- Adjust the capacitor of the probe in order to obtain an undistorted display. See Fig. 7.3.1.
- Remove the probe from the YA input and connect it to the YB input.
- The display must be undistorted.
  If necessary, adjust C122.

7.4.2.2. Gain R121 (R171)

- Apply an amplitude calibrated 1 kHz square-wave signal of 0,12 $V_{p\text{-}p}$ to the YA input connector.
- YA - V/DIV switch to position .03.
- The vertical deflection must be 4 divisions. If necessary, adjust R121.
- Repeat the procedure for the YB channel.
  If necessary, adjust R171.

7.4.2.3. Attenuator response

In following procedure the attenuator frequency response and the input capacitance are checked at different positions of the V/DIV switches.
Before this procedure is carried out the input capacitances of YA and YB must be equal at V/DIV switch setting .03.
Refer to para. 7.4.2.1.

- Connect a 50 ohm, 1 kHz, square-wave generator via a 50 ohm cable and a 50 ohm termination pad to the YA input connector.
- In all below-mentioned V/DIV switch positions, the generator output voltage must be set for a vertical deflection of 4 divisions.
- YA - V/DIV switch to position .1.
- The displayed waveform must be undistorted. See Fig. 7.3.1.
  If necessary, adjust C12.
- YA - V/DIV switch to position .3.
- The displayed waveform must be undistorted.
  If necessary, adjust C14.
- YA - V/DIV switch to position 1.
- The displayed waveform must be undistorted.
  If necessary, adjust C17.
- Repeat this procedure for the YB input.
  If necessary, adjust C22, C24 or C27 respectively.
- Connect a 1:10 attenuator probe to the YA input connector.
- Connect the probe-tip direct to the square-wave generator output.
- YA - V/DIV switch to position .03.
- If necessary, adjust the probe capacitor to obtain an undisturbed display.
- If the probe is removed from the YA and connected to the YB connector, the YB - V/DIV switch being in position .03, the display must be the same.
- Reconnect the probe connector to the YA input.
- YA - V/DIV switch to position 0.1.
- The displayed waveform must be undistorted.
  If necessary, adjust C11.
- YA - V/DIV switch to position 0.3.
- The displayed waveform must be undistorted.
  If necessary, adjust C15.
- YA - V/DIV switch to position 1.
- The displayed waveform must be undistorted.
  If necessary, adjust C18.
- Repeat this procedure for the YA input.
  If necessary, adjust C21, C25 or C28 respectively.

7.4.2.4. 100 kHz square-wave response

- Both V/DIV switches to position .03.
- Apply a 100 kHz signal to the YA or YB input connector.
- Set the generator output voltage for a vertical deflection of 4 divisions.
  If necessary, adjust C144 for optimum square-wave response.
  If necessary, adjust C115 (for the A channel) or C135 (for the B channel) for the best leading edge.

7.4.2.5. Upper bandwidth limit

- Connect a 50 ohm, constant amplitude sine-wave signal generator, via a 50 ohm cable and a 50 ohm termination pad to the YA or YB input connector.
- Input frequency 50 kHz.
- V/DIV switches in position .03.
- Set the generator output voltage for a vertical deflection of 4 divisions.
- Change the input frequency to 5 MHz (at constant voltage).
  The variation of the deflection should be 3 dB at max. (the deflection may not be less than 2,8 divisions).

7.4.2.6. Linearity

- Connect a generator to the YA input as indicated in para 7.4.2.5.
- Input frequency 50 kHz.
- Set the input voltage for a vertical deflection of 2 divisions.
- Move the display up and down with the YA position knob as indicated in Fig. 7.4.
- The variation in amplitude of the display (in vertical direction) must be less than 0,1 division.
- Repeat at input frequency of 5 MHz.
- Repeat this procedure for the YB input.

7.5. TRIGGER, TIME-BASE AND X-AMPLIFIER (PM 3000 and PM 3010)

See Fig. 7.6.

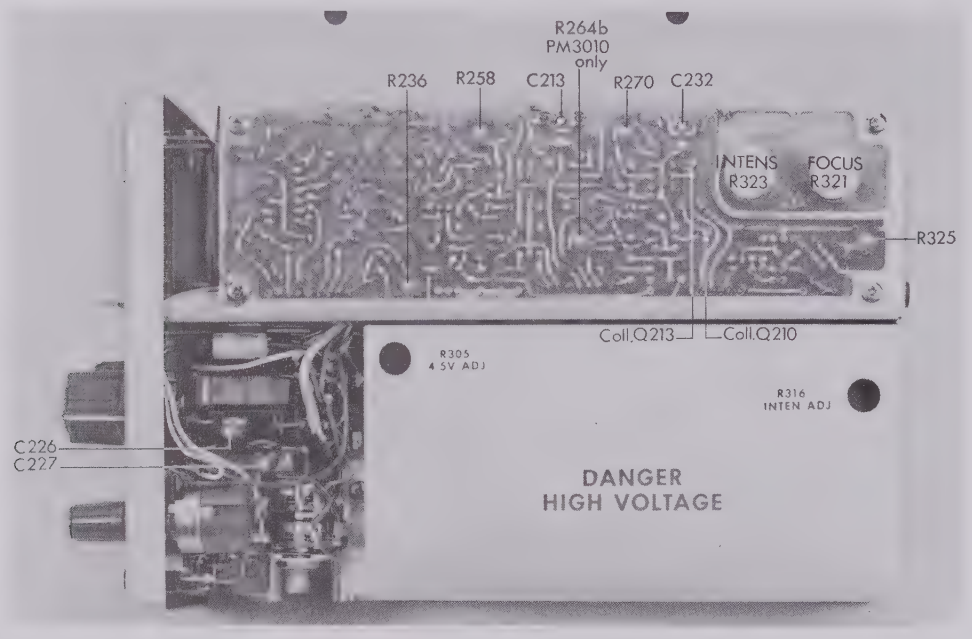


Fig. 7.6. PM 3000 and PM 3010, Trigger, Time-base, X-amplifier adjustment points

7.5.1. Trigger freerun level

- Y input switch to position 0.
- Pull the LEVEL knob to assume the Normal sweep mode.
  No trace may appear.
- Y input switch to position AC.
- Apply a 50 kHz sine-wave signal to the Y input connector.
- Set the input signal for a vertical deflection of 0,5 div.
- Rotate the LEVEL knob for a stationary display (in both AUTO and Normal mode).
  If necessary, the freerun level must be adjusted as follows:
- Y input switch to position 0.
- Pull the LEVEL knob (Normal sweep mode).
  Set the knob to mid-position (0).
- Connect a digital V meter between the base of Q203 and chassis to measure the d.c. level.
- While adjusting R236 (stab. adj.), measure the voltage just before the circuit starts free-running.
- Set R236 to obtain a value of 0,1 V higher than the just-measured voltage.

7.5.2. Trigger sensitivity

Trigger sensitivity is checked in accordance with following table:

Trigger source	Input frequency	Input level
INT	30 Hz ... 2 MHz	0,5 div.
	2 MHz ... 5 MHz	1 div.
EXT	30 Hz ... 5 MHz	0,2 V

7.5.3. Trigger slope

- Apply a 1 kHz sine-wave signal to the Y-input connector.
- Set the input signal for a vertical deflection of 1 division.
- Adjust the LEVEL knob for a stable display.
- No disturbance should occur on the display when +/– switch is activated.
  The display must be correctly inverted.
- The same procedure must be followed with a 1 kHz sine-wave signal of 0,5 V_{p-p} coming from the same generator and applied to the EXT. trigger input socket.

7.5.4. Sweep length

- Apply a 1 ms marker signal to the Y input.
- TIME/DIV switch to position 1 ms.
- Set the oscilloscope out of triggering, to obtain a freerunning display.
- The sweep length must be 7 divisions.
  If necessary, adjust R258.
- When a stationary display has been set with the TRIGGER control, make sure that the trace (sweep length) did not become shorter than 6 divisions.

7.5.5. Sweep time/division

- First check the sweep length as indicated in para. 7.5.4.
- Apply a 1 ms marker signal to the Y input.
- TIME/DIV switch to position 1 ms.
- Set the TRIGGER controls to obtain a stable display.
- Check the sweep time (the markers must coincide with the vertical graticule lines of the c.r.t.).
  If necessary, adjust R270.
- TIME/DIV switch to position 10 μs.
- Marker signal: 10 μs.
- Check the sweep time.
  If necessary, adjust C226.
- TIME/DIV switch to 1 μs.
- Marker signal: 1 μs.
- Check the sweep time.
  If necessary, adjust C227.

7.5.6. Linearity

- TIME/DIV switch to 1 μs.
- Apply a 1 μs marker signal to the Y input.
- Centre the display with the X POSITION knob.
- Check the display for non-linearity.
  If necessary, adjust C213.
- Check for display linearity at the edges of the viewing area, while shifting the display from the left to right and vice versa with the X POSITION control.
- If necessary, adjust C234.

7.5.7. TB magnifier x10 (PM 3010 only)

- TIME/DIV switch to 1 ms.
- Apply a 0,1 ms marker signal to the Y input.
- TB MAGN. switch to position x10.
- X position knob in middle position.
- Check the sweep time (the markers must coïncide with the vertical graticule lines).
  If necessary, adjust R264b.

8. Service parts

8.1. MECHANICAL PARTS

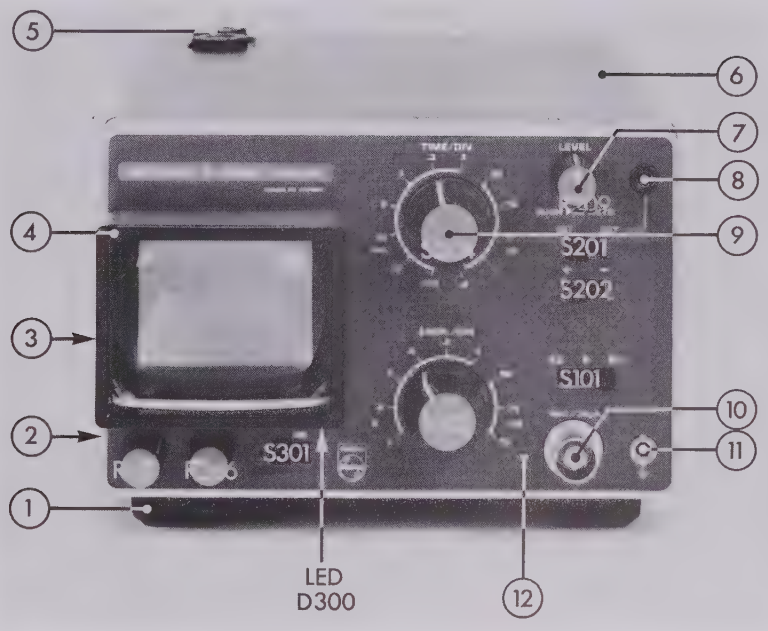


Fig. 8.1. Front view PM 3000

Item	*Description*	*Qty*	*Code number*
1	Tilting bracket	1	5322 462 14005
	Bracket hinges	2	5322 462 44149
2	Rear foot	2	5322 462 44152
3	C.r.t. bezel	1	5322 450 74005
4	Lens	1	5322 381 44016
5	Black knob	2	5322 414 34131
	White insulator knob	2	5322 414 34132
	Screw M2x6	2	5322 502 10745
6	Cabinet	1	5322 447 94142
7	Knob black, dia 10 mm, shaft 1/8"	3	5322 414 34133
	Cap of knob, grey	3	5322 414 74015
8	Trigg. input connector (2 mm)	1	5322 268 24038
9	Knob black, dia 18 mm, shaft 4 mm	2	5322 414 34076
	Cap of knob, grey	2	5322 414 74015
	Bushing 1/8"-4 mm	2	5322 532 24355
10	BNC connector	1	5322 267 10004
11	Earth connector	1	
12	Front panel	1	5322 455 84032

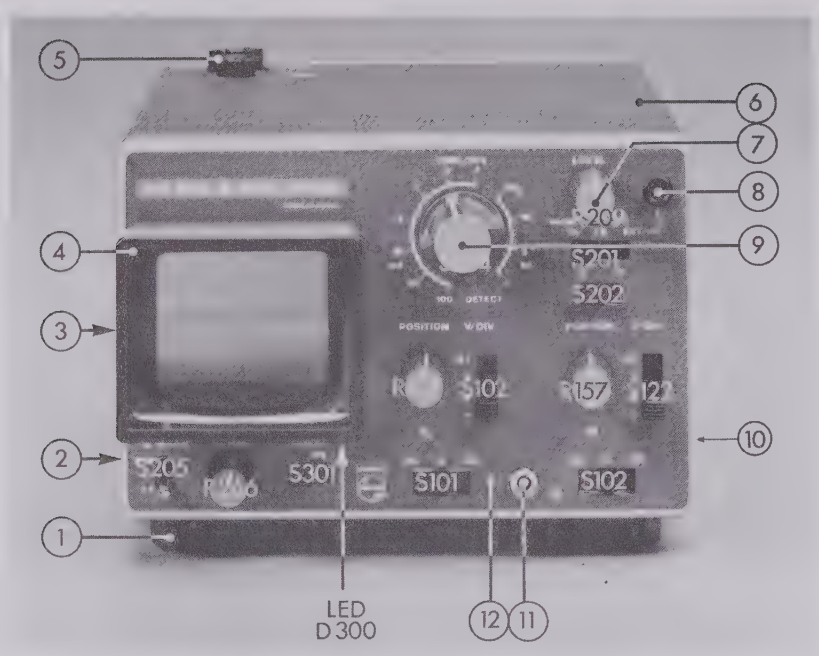


Fig. 8.2. Front view PM 3010

Item	*Description*	*Qty*	*Code number*
1	Tilting bracket	1	5322 462 14005
	Bracket hinges	2	5322 462 44149
2	Rear foot	2	5322 462 44152
3	C.r.t. bezel	1	5322 450 74005
4	Lens	1	5322 381 44016
5	Black knob	2	5322 414 34131
	White insulator knob	2	5322 414 34132
	ScrewM2x6	2	5322 502 10745
6	Cabinet	1	5322 447 94154
7	Knob black, dia 10 mm, shaft 1/8"	4	5322 414 34133
	Cap of knob, grey	4	5322 414 74015
8	Trigg. input connector (2 mm)	1	5322 268 24038
9	Knob black, dia 18 mm, shaft 4 mm	1	5322 414 34076
	Cap of knob, grey	1	5322 414 74015
	Bushing 1/8"-4 mm	1	5322 532 24355
10	BNC connector	2	5322 267 10004
11	Earth connector (2 mm)	1	
12	Front panel	1	5322 455 84035

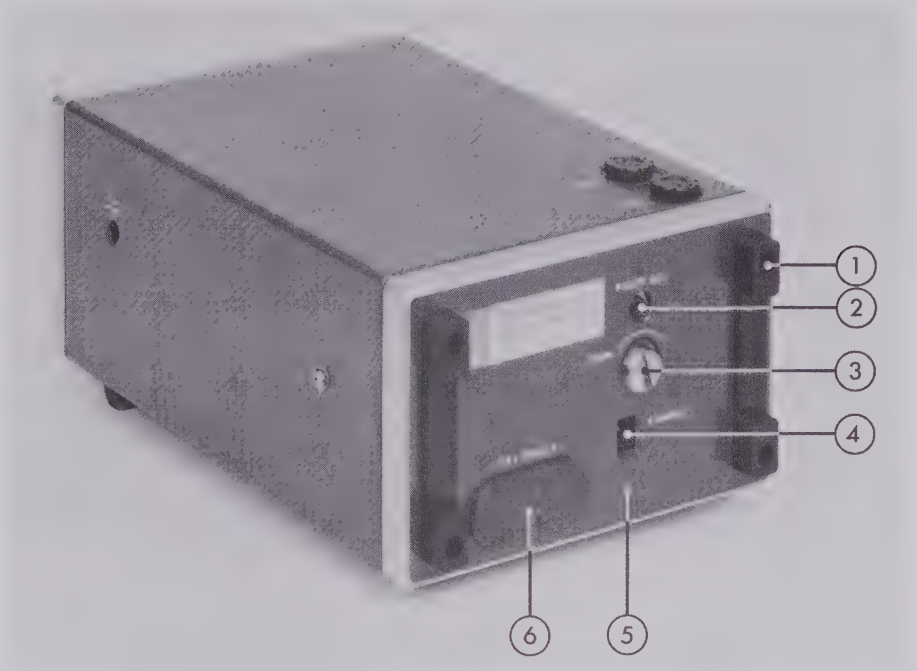


Fig. 8.3. Rear view

Item	*Description*	*Qty*	*Code number*
1	Foot	2	5322 462 44151
2	Probe Adj. connector (2 mm)	1	5322 268 24038
3	Retaining screw	1	5322 500 14161
	Plastic washer	1	5322 532 54243
	E type clip	1	4822 530 70123
4	"Charge" female connector	1	
	Relevant male connector	1	5322 263 64011
5	Rear panel	1	5322 455 84033
6	Cover	1	5322 325 64046

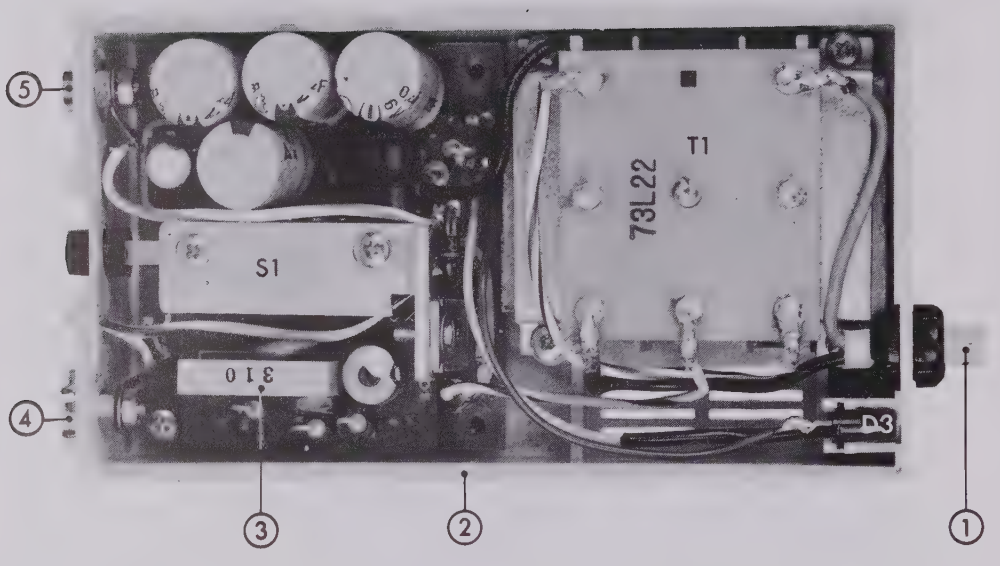


Fig. 8.4. A.C. Power Supply PM 9398

Item	*Description*	*Qty*	*Code number*
1	Mains cord with europlug	1	4822 321 10095
2	Cabinet	1	5322 447 94157
	Cover of cabinet	1	5322 447 94158
3	P.C. unit BQ-A6 compl.	1	5322 216 54103
4	Female button contact	1	5322 268 24039
5	Male button contact	1	5322 268 14054

VARIOUS PARTS

Description	*Code number*
Carrying case	5322 600 74002
Small case for test wires	5322 600 74001
Cathode ray tube type 40DB31	5322 131 24023
C.r.t. socket	5322 255 74014
Connection plate with button contacts	5322 290 44004
Print connector supply and h.v. board	5322 267 54093
Screw M2,5x8	4822 502 10909

8.2. ELECTRICAL PARTS

Item	*Ordering number*	*F/Ω*	*%*	*V or Style*
Y AMPLIFIER				
PM 3000				
C11	5322 125 64006	20p	trimmer	100
C12	5322 125 64007	10p	trimmer	100
C13	4822 122 31203	39p	5	250
C14	5322 125 64006	20p	trimmer	100
C15	5322 125 64008	10p	trimmer	100
C16	5322 121 54047	270p	1	250
C101	4822 121 40342	47n	10	500
C102	4822 122 31196	12p	5	500
C103	4822 122 31175	1n	20	500
C104	4822 122 31219	150p	5	500
C105	4822 122 31198	18p	5	500
C106	4822 122 31208	82p	5	500
C107	5322 125 54011	50p	trimmer	500
C108	4822 121 50418	390p	1	250
C109	5322 122 14005	2p	5	500
C110	4822 124 20475	10 μ	−20 +50	16
C111, 112	4822 124 20462	100 μ	−20 +50	10
C113	5322 122 31205	47p	5	500
C115	5322 124 24118	3,3 μ	−20 +50	160
R11	4822 116 51127	900K	1	MR30
R12	5322 116 54213	111K	1	MR30
R13	5322 116 51021	990K	1	MR30
R14	5322 116 54211	10,1K	1	MR25
R15	4822 111 30312	470	5	CR16
R101	5322 116 54188	1M	1	MR30
R102	4822 110 53187	1M	5	CR37
R103	4822 110 53141	18K	5	CR25
R104	5322 101 14078	5K	potm.	0,1 W
R105	4822 110 53141	18K	5	CR25
R106	4822 111 30269	1K	5	CR16
R107, 108	4822 111 30314	6,8K	5	CR16
R109	5322 101 14074	50K	potm.	0,1 W
R110A	5322 116 54455	68	1	MR25
R110B	5322 101 14075	220	potm.	0,1 W
R111A	5322 116 54513	330	1	MR25
R111B	5322 101 14076	500	potm.	0,1 W
R112	4822 111 30275	15K	5	CR16
R113	4822 111 30438	330	5	CR16
R114	4822 111 30269	1K	5	CR16
R115	4822 111 30275	15K	5	CR16
R116	4822 111 30269	1K	5	CR16
R117	5322 116 54535	680	1	MR25
R118	5322 101 14076	500	potm.	0,1 W
R119, 120	4822 111 30314	6,8K	5	CR16

Item	*Ordering number*	*F/Ω*	%	*V or Style*
R121	4822 111 30323	270	5	CR16
R122	5322 116 50437	240	1	MR25
R123, 124	4822 111 30268	1,2K	5	CR16
R125, 126	4822 111 30324	100	5	CR16
R127	4822 111 30274	12K	5	CR16
R128	4822 111 30308	120K	5	CR16
R129, 130	4822 110 53134	10K	5	CR37
R131	4822 111 30308	120K	5	CR16
S101	5322 277 24024	Slide switch 2 pole, 3 pos.		
S102	5322 273 54026	Rotary switch 3 pole, 10 pos.		
PM 3010				
C11, 21	5322 125 64006	20p	trimmer	100
C12, 22	5322 125 64007	10p	trimmer	100
C14, 24	5322 125 64007	10p	trimmer	100
C15, 25	5322 125 64006	20p	trimmer	100
C16, 26	4822 122 31203	39p	5	250
C17, 27	5322 125 64007	10p	trimmer	100
C18, 28	5322 125 64006	20p	trimmer	100
C19, 29	4822 122 30021	100p	2	120
C101, 121	4822 121 41134	10n	20	100
C102, 122	5322 125 64007	10p	trimmer	100
C103, 123	4822 122 31175	1n	20	500
C108, 128	4822 122 30128	4,7n	20	100
C109, 129	4822 124 20475	10 µ	−20 +50	16
C110, 130	4822 122 31028	4,7n	20	100
C111, 131	4822 124 20475	10 µ	−20 +50	16
C112, 132	4822 122 30128	4,7n	20	100
C113, 133	4822 122 30128	4,7n	20	100
C114, 134	4822 122 31203	39p	5	250
C115, 135	5322 125 54011	50p	trimmer	500
C136, 137	5322 122 14005	2p		100
C141, 142	4822 122 30128	4,7n	20	100
C143	4822 122 31207	68p	5	500
C144	5322 125 54011	50p	trimmer	500
C145	5322 121 54057	180p	1	
C146	4822 122 30128	4,7n	20	100
C148	4822 121 41147	33n	10	250
C180	4822 122 31175	1n	20	500
C181, 183	5322 122 31205	47p	5	500
C182	4822 122 30128	4,7n	20	100
C184	4822 122 31211	100p	5	500
C185	4822 122 30128	4,7n	20	100
C187	4822 122 31165	330p	5	500
C188	4822 122 30128	4,7n	20	100
R11, 21	5322 116 50465	700K	1	MR30
R12, 22	5322 116 50355	429K	1	MR25
R13, 23	5322 116 51127	900K	1	MR30
R14, 24	5322 116 54213	111K	1	MR30
R15, 25	5322 116 50395	970K	1	MR30

Item	*Ordering number*	*F/Ω*	*%*	*V or Style*
R16, 26	5322 116 54656	30,9K	1	MR25
R101, 151	5322 116 54188	1M	1	MR30
R102, 152	5322 116 54188	1M	1	MR30
R107, 157	5322 101 14074	50K	potm.	0,1 W
R108, 158	4822 110 63185	820K	5	CR25
R109, 159	5322 116 54683	68K	1	MR25
R110, 160	5322 116 54568	1,8K	1	MR25
R111, 161	4822 111 30324	100	5	CR16
R112, 162	5322 116 54003	22K	1	MR25
R113. 163	5322 116 54003	22K	1	MR25
R114, 164	5322 116 54012	6,8K	1	MR25
R115, 165	5322 116 54012	6,8K	1	MR25
R116, 166	5322 116 54549	1K	1	MR25
R117, 167	5322 116 54549	1K	1	MR25
R118, 168	5322 116 54002	220	1	MR25
R119, 169	5322 116 54002	220	1	MR25
R120, 170	5322 116 54009	560	1	MR25
R121, 171	5322 101 14076	500	potm.	0,1 W
R122, 172	5322 116 50527	33	1	MR25
R123, 173	5322 116 54003	22K	1	MR25
R124, 174	5322 116 54003	22K	1	MR25
R131, 132	5322 116 54568	1,8K	1	MR25
R133	4822 111 30324	100	5	CR16
R134	5322 116 50482	33K	1	MR25
R135	5322 116 54671	47K	1	MR25
R136, 137	5322 116 54574	2,2K	1	MR25
R138	5322 116 54541	820	1	MR25
R139	5322 116 54503	270	1	MR25
R140, 141	5322 116 54005	270	1	MR25
R142, 143	4822 111 30324	100	5	CR16
R144, 145	4822 110 53134	10K	5	CR37
R181	5322 116 54568	1,8K	1	MR25
R182	5322 116 50482	33K	1	MR25
R183	4822 111 30324	100	5	CR16
R184	5322 116 54568	1,8K	1	MR25
R185	5322 116 50482	33K	1	MR25
R186, 187	5322 116 54619	10K	1	MR25
R189	5322 116 54595	5,1K	1	MR25
R190	5322 116 54008	4,7K	1	MR25
R191	4822 111 30324	100	5	CR16
R192	5322 116 54557	1,2K	1	MR25
R193	5322 116 50527	33	1	MR25
R194, 195	5322 116 54619	10K	1	MR25
R196	4822 110 61161	100K	5	CR25
R197	5322 116 54619	10K	1	MR25
S101, 121	5322 277 24024	Slide switch 2 pole, 3 pos.		
S102, 122	5322 277 24025	Slide switch 2 pole, 4 pos.		
T101	5322 158 14089	Blocking transformer		

Item	*Ordering number*	*F/Ω*	*%*	*V or Style*
TRIGGER, TIME-BASE AND X-AMPLIFIER				
C200	4822 122 30114	2,2n	20	100
C201	4822 121 41134	10n	20	100
C202	4822 122 31173	220p	5	500
C203	4822 124 20475	10 μ	−20 +50	16
C204	4822 122 31198	18p	5	500
C205	4822 122 31205	47p	5	500
C206	4822 122 31197	15p	5	500
C207	4822 122 31198	18p	5	500
C208	4822 124 10195	470n	−20 +50	16
C209	5322 124 14062	1 μ	−20 +50	25
C210, 211	4822 124 20475	10 μ	−20 +50	16
C212	4822 122 31173	220p	5	500
C213	5322 125 54011	30p	trimmer	100
C214	4822 122 30128	4,7n	20	100
C215	4822 124 20461	47 μ	−20 +50	10
C216	4822 122 31202	33p	20	500
C217	5322 122 44006	10n	5	250
C218	4822 122 31206	56p	5	250
C221	5322 121 54067	1 μ	1	16
C222	5322 121 54068	100n	1	25
C223	4822 121 50097	10n	1	25
C224	5322 121 54069	1n	0,5	25
C225	4822 122 31076	68p	1	25
C226, 227	5322 125 64006	20p		100
C230	4822 124 20475	10 μ	−20 +50	16
C231	4822 124 10195	470n	20	25
C232	4822 121 50553	470p	1	150 PM 3010
C233	4822 122 31208	39p	5	250
C234	5322 125 54011	30p	trimmer	100
C281	4822 122 31116	2,2n	5	250
R201	4822 110 53187	1M	5	CR37
R202	4822 110 63161	100K	5	CR25A
R203	4822 110 63141	18K	5	CR25A
R204	4822 110 63118	2,7K	5	CR25A
R205, 206	4822 110 63123	3,9K	5	CR25A
R207	4822 110 63129	6,8K	5	CR25A
R208	4822 111 30276	18K	5	CR16
R209	5322 101 24043	50K	potm.	0,1 W
R210	5322 111 30291	68K	5	CR16
R211	5322 111 30256	270K	5	CR16
R215	4822 110 63109	1,2K	5	CR25A
R216	4822 110 63134	10K	5	CR25A
R217	4822 110 63109	1,2K	5	CR25A
R218	4822 110 60099	510	5	CR25A
R219	4822 110 63105	820	5	CR25A
R220, 221	4822 110 63134	10K	5	CR25A
R222	4822 110 63101	560K	5	CR25A
R223	4822 110 63107	1K	5	CR25A
R224	4822 110 63123	3,9K	5	CR25A
R225	4822 110 63107	1K	5	CR25A

Item	*Ordering number*	*F/Ω*	*%*	*V or Style*
R226	4822 110 63134	10K	5	CR25A
R227	4822 110 63152	47K	5	CR25A
R228	4822 110 63163	120K	5	CR25A
R229	4822 110 63107	1K	5	CR25A
R230	4822 110 63129	6,8K	5	CR25A
R231	4822 110 63107	1K	5	CR25A
R234	4822 110 63163	100K	5	CR25A
R235	4822 110 63123	3,9K	5	CR25A
R236	5322 101 14073	2K	potm.	0,1 W
R237	4822 110 63112	1,5K	5	CR25A
R238	5322 111 30295	24K	5	CR16
R239	4822 110 63178	470K	5	CR25A
R240	4822 110 63158	82K	5	CR25A
R241	4822 110 63143	22K	5	CR25A
R242, 243	4822 110 63127	5,6K	5	CR25A
R244	4822 110 63134	10K	5	CR25A
R245	4822 110 63116	2,2K	5	CR25A
R246	4822 110 63125	4,7K	5	CR25A
R247	4822 110 60157	75K	5	CR25A
R248	4822 110 63161	100K	5	CR25A
R249	4822 110 63167	180K	5	CR25A
R250	5322 116 50355	427K	0,5	MR30
R251	5322 116 50937	182K	0,5	MR30
R252	5322 116 54679	60K	0,5	MR25
R255, 256	4822 110 63081	100	5	CR25A
R257	4822 110 63132	8,2K	5	CR25A
R258	5322 101 14078	5K	potm.	0,1 W
R259	4822 110 63138	15K	5	CR25A
R260	4822 110 60144	24K	5	CR25A
R261	4822 110 63161	100K	5	CR25A
R262	4822 110 63154	56K	5	CR25A
R263	4822 110 63081	100	5	CR25A
R264a	5322 116 54007	470	1	MR25
R264b	5322 101 14077	1K	potm.	0,1 W
R265	4822 110 63136	12K	5	CR25A
R266	5322 101 14074	50K	potm.	0,1 W
R267	4822 110 63156	68K	5	CR25A
R268, 269	4822 110 63134	10K	5	CR25A
R270	5322 101 14078	5K	potm.	0,1 W
R271	5322 116 54578	2,7K	1	MR25
R272	5322 116 54638	18K	1	MR25
R273, 274	4822 110 63149	39K	5	CR25
R275	4822 110 63138	15K	5	CR25A
R276	4822 110 63141	18K	5	CR25A
R277	4822 110 63156	68K	5	CR25A
R278	5322 116 54638	18K	1	MR25
R279	4822 110 63156	68K	5	CR25A
R280	4822 110 63141	18K	5	CR25A
R281	4822 110 63147	33K	5	CR25A

Item	*Ordering number*	*F/Ω*	*%*	*V or Style*
R282	4822 110 54141	18K	5	CR25
R283	4822 110 53147	33K	5	CR25
R284	4822 110 63084	330	5	CR25A
R287	4822 110 63094	330	5	CR25A
R288	5322 116 54005	3,3K	1	MR25 (PM 3010)
S201, 202	5322 277 24019	Slide switch 2poles, 3 pos.		
S203	refer to R209			
S204	5322 273 64035	Rotary switch 4poles, 12 pos.		
S205	5322 277 10214	Toggle switch 2poles, 2 pos.		

POWER SUPPLY AND HIGH TENSION PART

C301	4822 124 20472	100 µ	–20 +50	16
C302	4822 124 20496	10 µ	–20 +50	50
C303	4822 124 20465	330 µ	–20 +50	10
C304	4822 124 20462	100 µ	–20 +50	10
C305	4822 121 41147	33n	20	250
C306 - 309	4822 124 20462	100 µ	–20 +50	10
C310, 311	4822 124 20316	4,7 µ	–20 +50	160
C312	4822 124 20494	4,7 µ	–20 +50	25
C315 - 322	5322 122 44007	3,3n		
C323, 324	5322 122 54003	4,7n		2000
C325, 332	5322 122 44007	3,3n		
C333, 335	5322 122 54003	4,7n		2000
C336	5322 124 24113	1 µ	–20 +50	160
C337	5322 122 54003	4,7n		2000
L301	5322 157 54034	Choke coil 200 µH		
L302	5322 157 54035	Trace rotation coil		
R300	4822 110 63161	100K	5	CR25A
R301	4822 110 63129	6,8K	5	CR25A
R302	4822 110 63121	3,3K	5	CR25A
R303	4822 110 63105	820	5	CR25A
R304	4822 110 63121	3,3K	5	CR25A
R305	5322 101 14076	500	potm.	0,1 W
R306	4822 110 63098	470	5	CR25A
R307	4822 110 63103	680	5	CR25A
R308	4822 110 30324	100	5	CR16
R309	4822 111 30328	330	5	CR16
R310	4822 110 63074	56	5	CR25A
R311, 312	5322 116 50983	22	1	MR25 PM 3000
R312	5322 116 50452	10	1	MR25 PM 3010
R313	4822 110 51056	12	5	CR37
R315	4822 110 63149	39K	5	CR25A
R316	5322 101 14081	1M	potm.	0,1 W
R317	4822 110 63169	220K	5	CR25A
R318	4822 110 42225	27M	10	0,5 W
R319a, b	5322 102 34007	2x2K	potm.	0,1 W
R320	4822 110 53201	3,3M	10	0,25 W
R321	5322 101 24044	2M	potm.	0,1 W
R322	5322 110 30215	11M	10	0,25 W
R323	5322 101 24044	2M	potm.	0,25 W
R324	4822 110 53187	1M	5	CR37
R325	5322 101 14081	1M	potm.	0,1 W
R326	5322 111 44132	33	5	CR16

Item	*Ordering number*	*F/Ω*	*%*	*V or Style*
S301	5322 277 24019	Slide switch 2poles, 2 pos.		
T301	5322 148 84015	Chopper transformer		
PM 9398				
C1 A, B, C, D	5322 124 24121	330 μ	–20 +50	16 V
C2	4822 124 20468	33 μ	–20 +50	16 V
F1	4822 253 20018	1 A fuse		
R1	5322 116 54619	10K	1	MR25
R2	5322 116 54549	1K	1	MR25
R3	5322 116 50572	12K	1	MR25
R4	5322 116 54009	560	1	MR25
R5	5322 116 54549	1K	1	MR25
S1	5322 276 14169	Slide switch 2poles, 2 pos.		
T1	5322 146 24096	Transformer		

SEMI CONDUCTORS

Item	*Type*	*Ordering code*	*Remarks*	
Diodes				
D1	10DC1	5322 130 34332		
D2	10DC1R	5322 130 34333		
D3	LN11	5322 130 34291	LED	PM 9398
D4	12D1	5322 130 34334		
D101, 102, 122	1S1690N	5322 130 34288		
D131, 132	BAX13	5322 130 40182		
D201...204	BAX13	5322 130 40182		
D206	SM150d	5322 130 34289		
D207	BAX13	5322 130 40182		
D300	LN11	5322 130 34291	LED	
D301...306	BAX13	5322 130 40182		
D307, 308	12D1	5322 130 34334		
D309	1S994	5322 130 34293	Z diode 4 V	
Integrated circuits				
IC1	BQ-A6	5322 216 54103		PM 9398
IC101, 121	SN72733	5322 209 84495		PM 3010
IC102	N8731A	5322 209 84494		
IC201	CA3086	5322 209 84111		
IC301...304	VMC406	5322 209 84407		
Transistors				
Q1	2SC828-PQ	5322 130 44351		PM 9398
Q2	2SD317-PQ	5322 130 44352		
Q101	FD1684	5322 130 44264	Dual fet	
Q102, 105	2SC645-B	5322 130 44265		PM 3000
Q106, 107	BSX20	5322 130 40417		
Q108, 109	TC538A12	5322 130 44314		
Q101, 121	FD1684	5322 130 44264	Dual fet	PM 3010
Q102, 103, 122, 123	2SC538A-R	5322 130 40766		
Q104, 105, 124, 125	2SC645-B	5322 130 44265		
Q106, 107	2SA564A-RS	5322 130 44315		
Q108, 109	BSX20	5322 130 40417		
Q110, 111	TC538A12	5322 130 44314		
Q131, 132, 134	2SC828-S	5322 130 44318		
Q133	2SC1550	5322 130 44317		
Q201	2SK12R	5322 130 44267	Fet	
Q202	2SC829-C	5322 130 44319		
Q203, 204	2SC645-B	5322 130 44265		
Q205	BSX20	5322 130 40417		
Q206	2SK12R	5322 130 44267	Fet	
Q207	2SA564-RS	5322 130 44315		
Q208, 209	2SC829-C	5322 130 44319		
Q210, 213	2SC1550	5322 130 44317		
Q211, 212	2SC828-S	5322 130 44318		
Q214	2SA564A-RS	5322 130 44315		
Q215, 216	2SC1550	5322 130 44317		
Q217, 218	2SC829-C	5322 130 44319		
Q301	2SC696A	5322 130 44269		
Q302	2SA564A-RS	5322 130 44315		
Q303	2SC828-S	5322 130 44318		
Q304, 305	2SC1518	5322 130 44316		

9. Figures

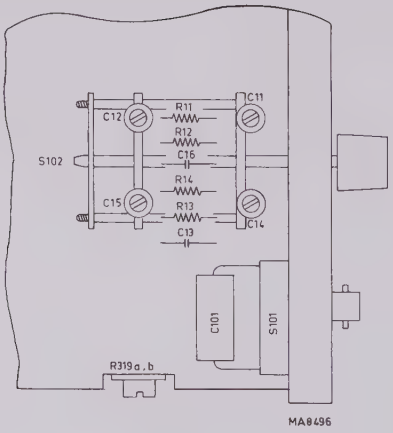


Fig. 9.1. Attenuator switch PM 3000

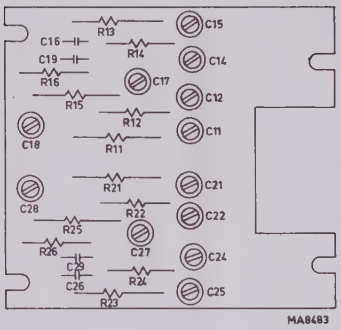


Fig. 9.2. Attenuator p.c. board PM 3010

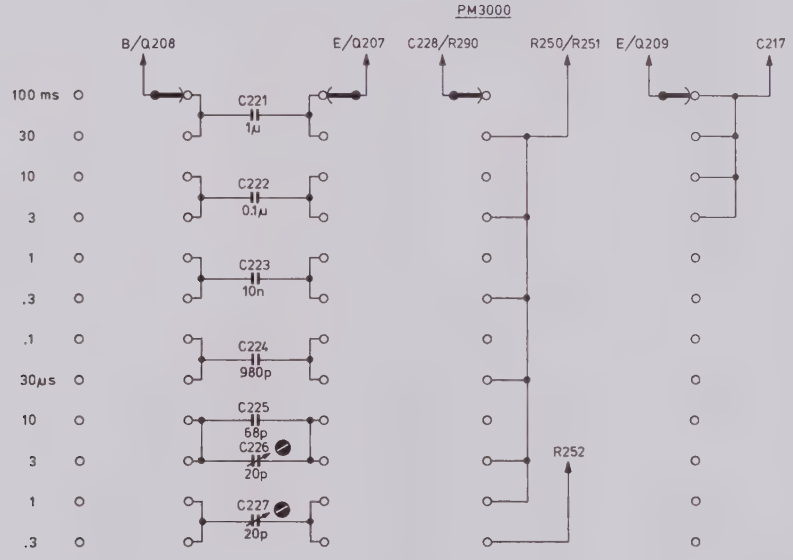


Fig. 9.3. Connections TIME/DIV switch PM 3000

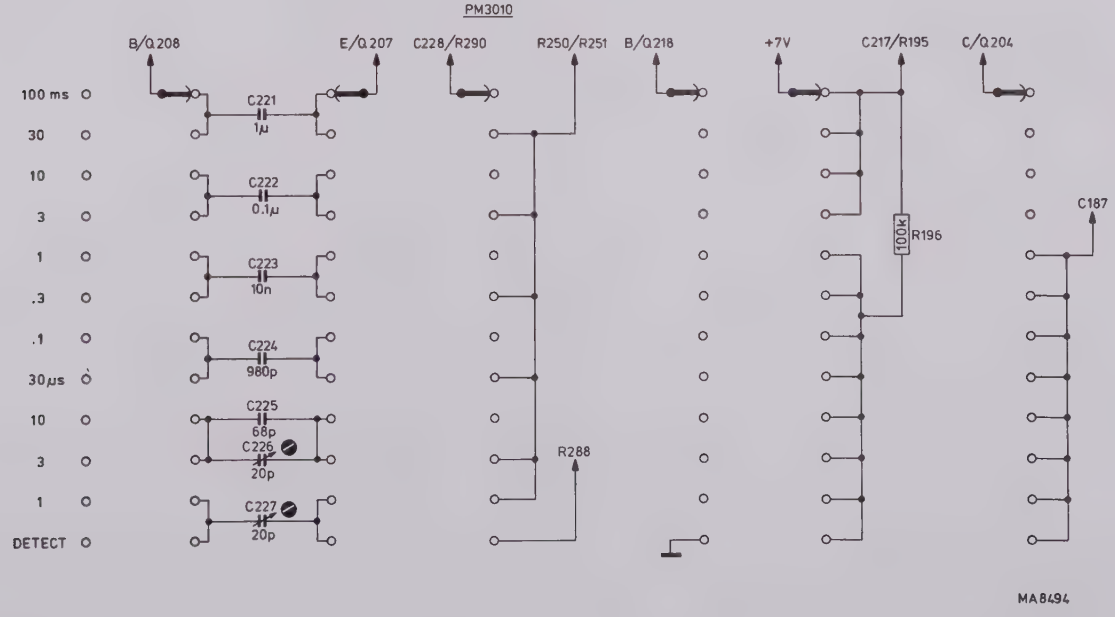
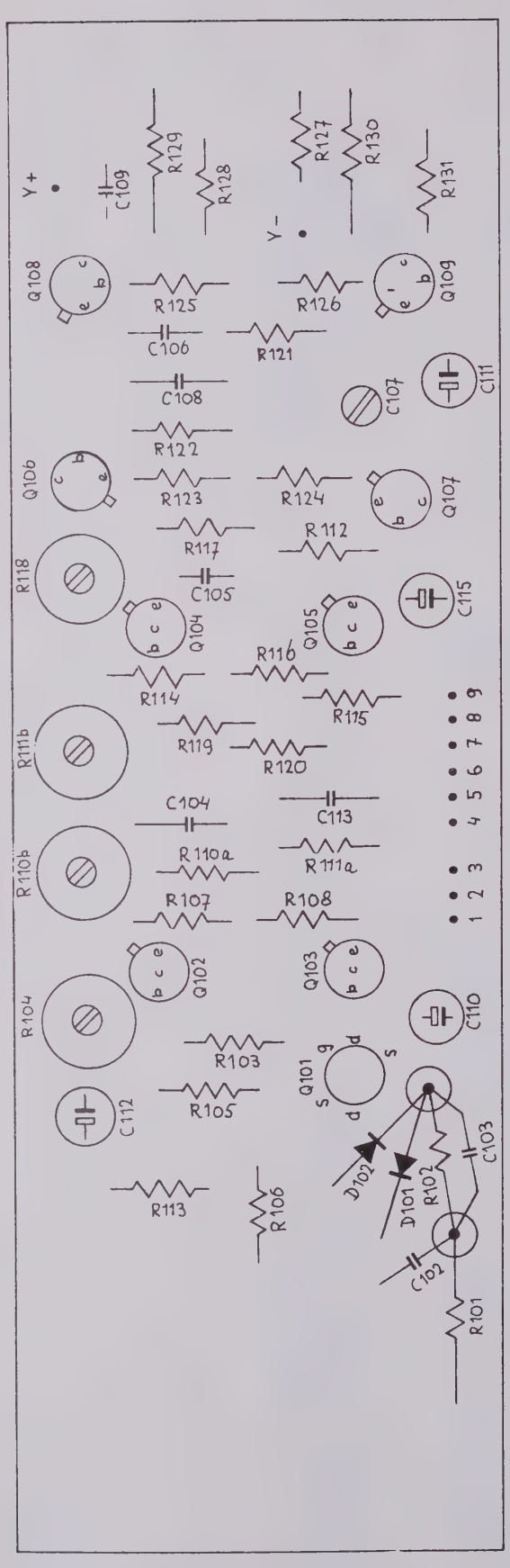


Fig. 9.4. Connections TIME/DIV switch PM 3010



1. 6. to S201 (Int. trig.)
2. 7. −7 V
3. to S102 8. +7 V
4. 9. +60 V
5. to R109 (Y position)

Fig. 9.5. P.C. board Y-amplifier PM 3000

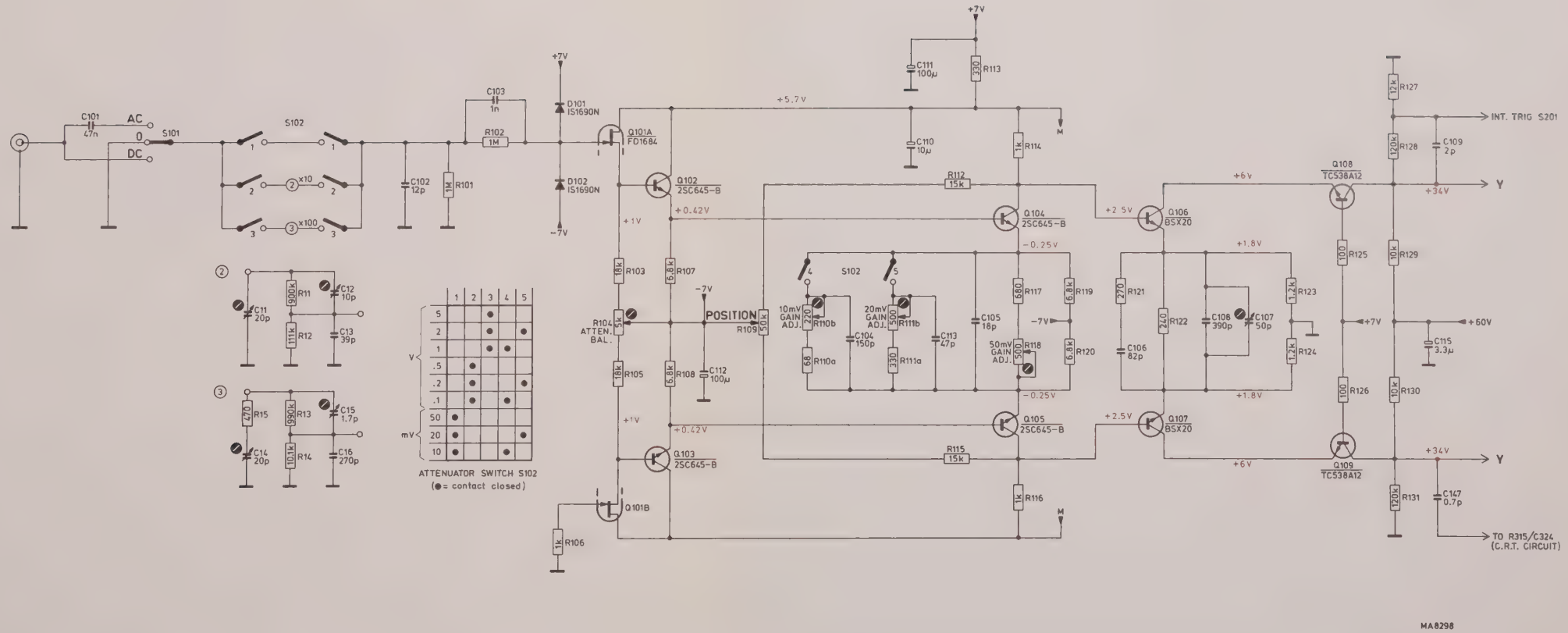


Fig. 9.6. Circuit diagram Y-amplifier PM 3000

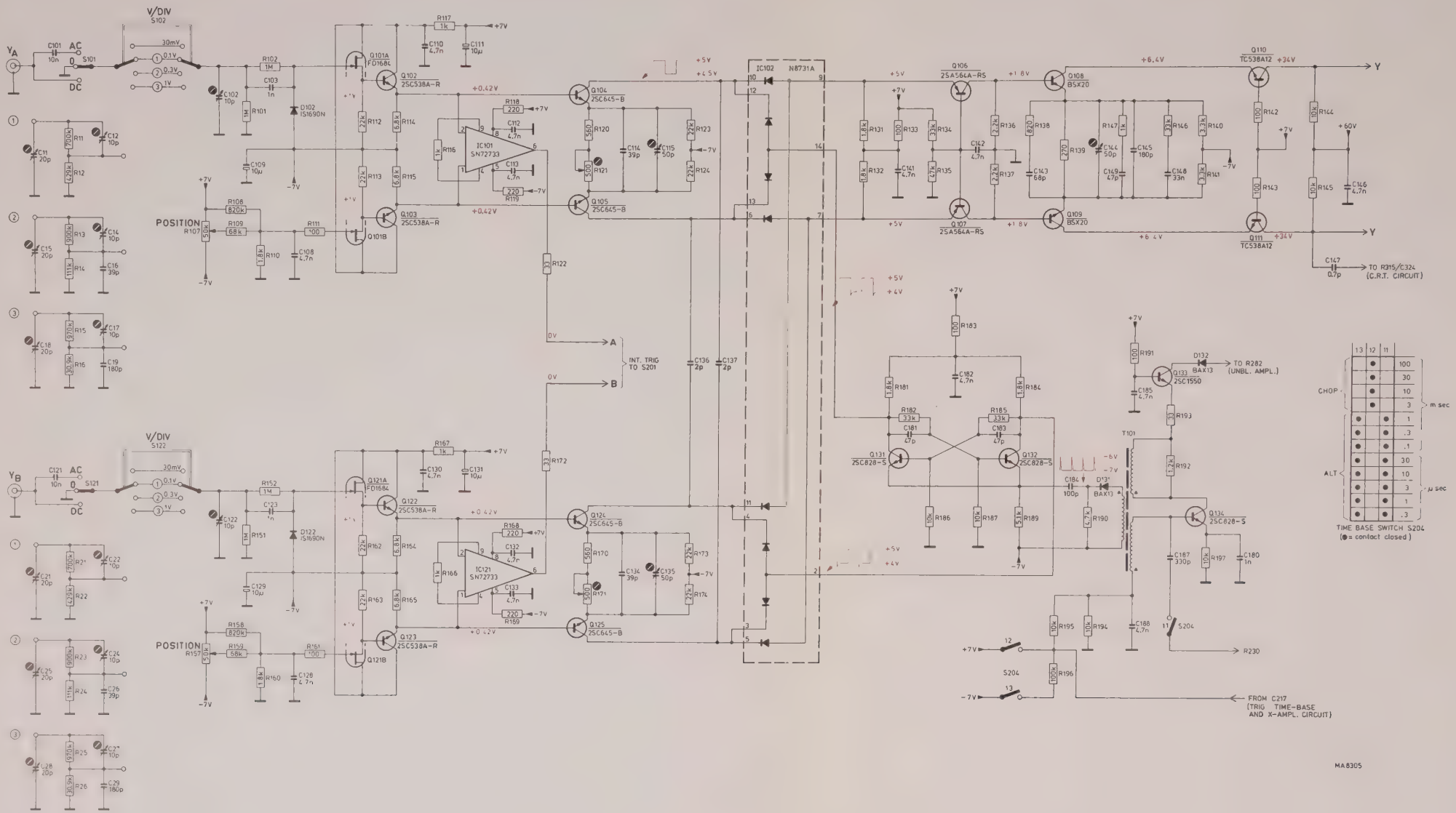


Fig. 9.7. Circuit diagram Y-amplifier PM 3010

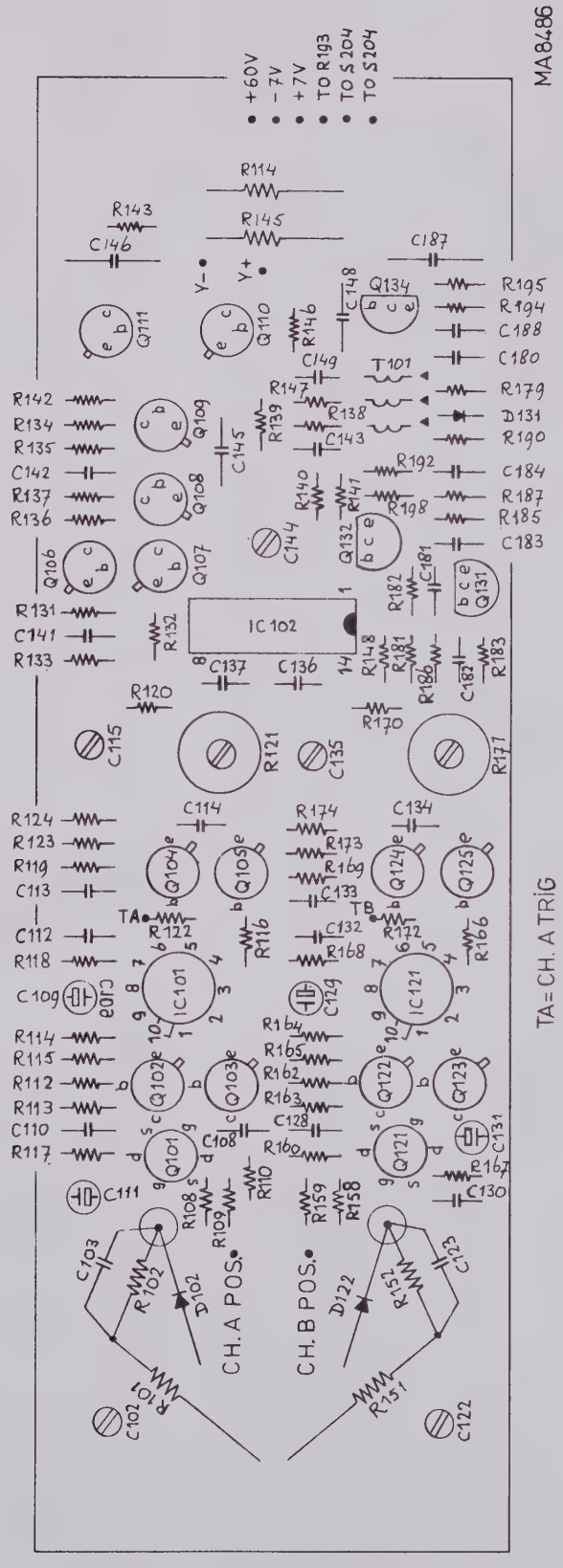


Fig. 9.8. P.C. board Y-amplifier PM 3010

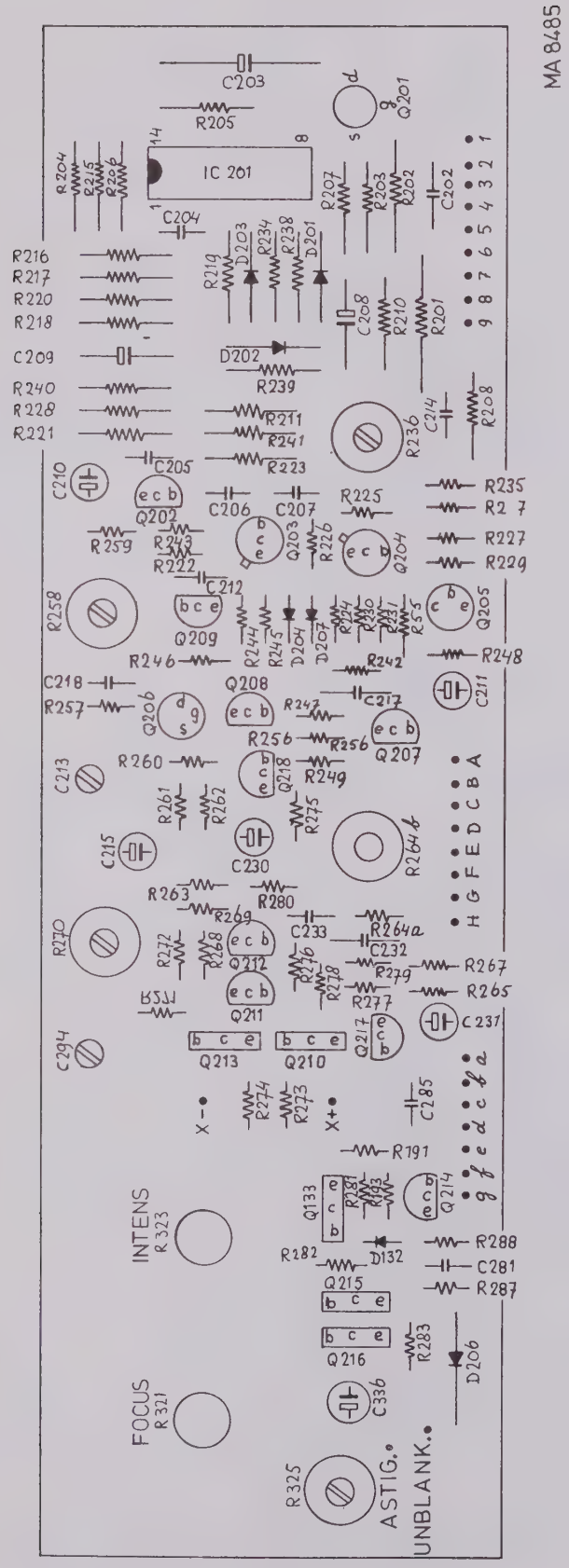


Fig. 9.9. P.C. board Trigg. Time-base and X-ampl. PM 3000/PM 3010

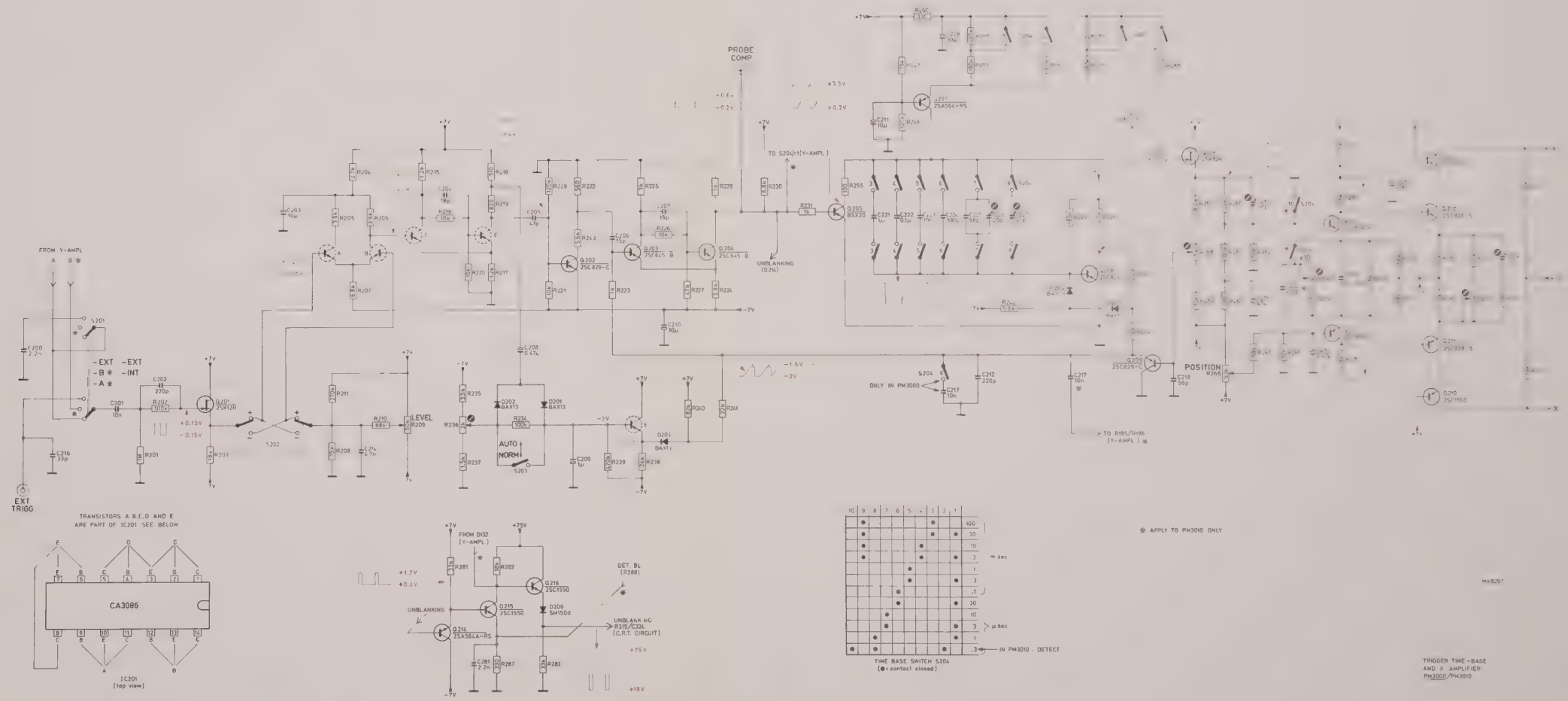


Fig. 9.10. Circuit diagram Trigg. Time-base and X-ampl PM 3000/PM 3010

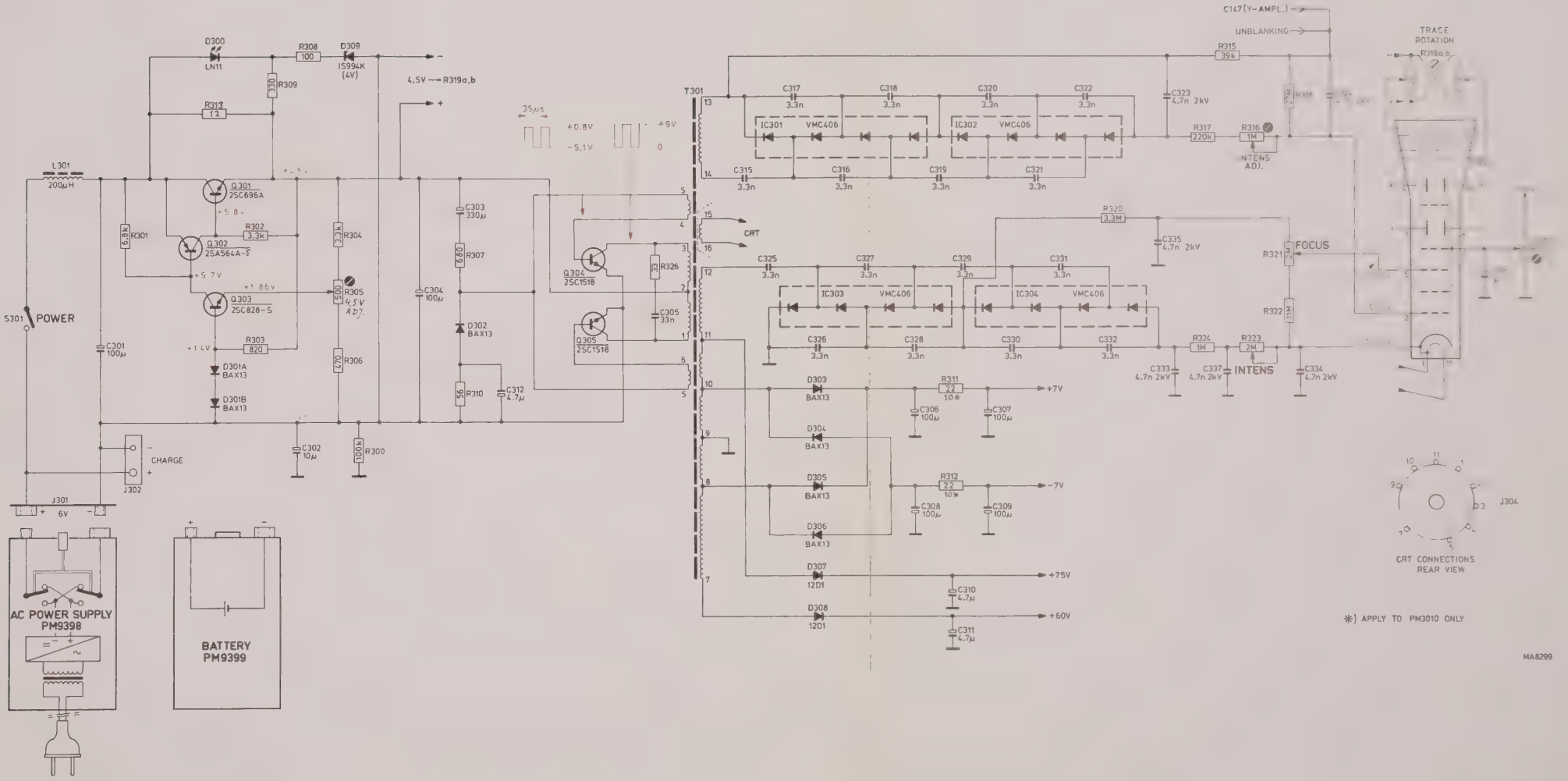


Fig. 9.11. Circuit diagram power supply and HV circuits

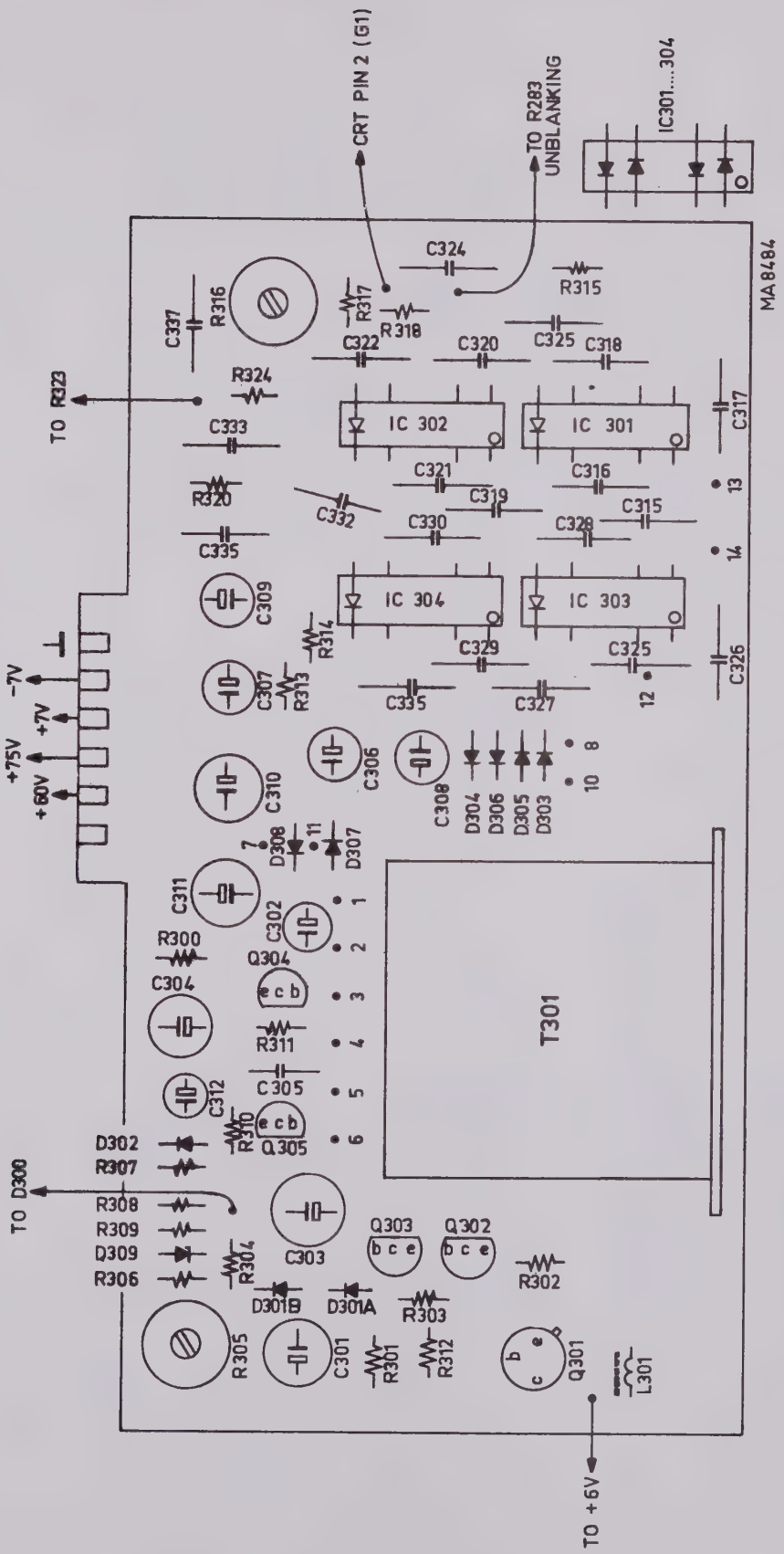


Fig. 9.12. P.C. board Power supply and HV circuits p.c. board PM 3000/PM 3010

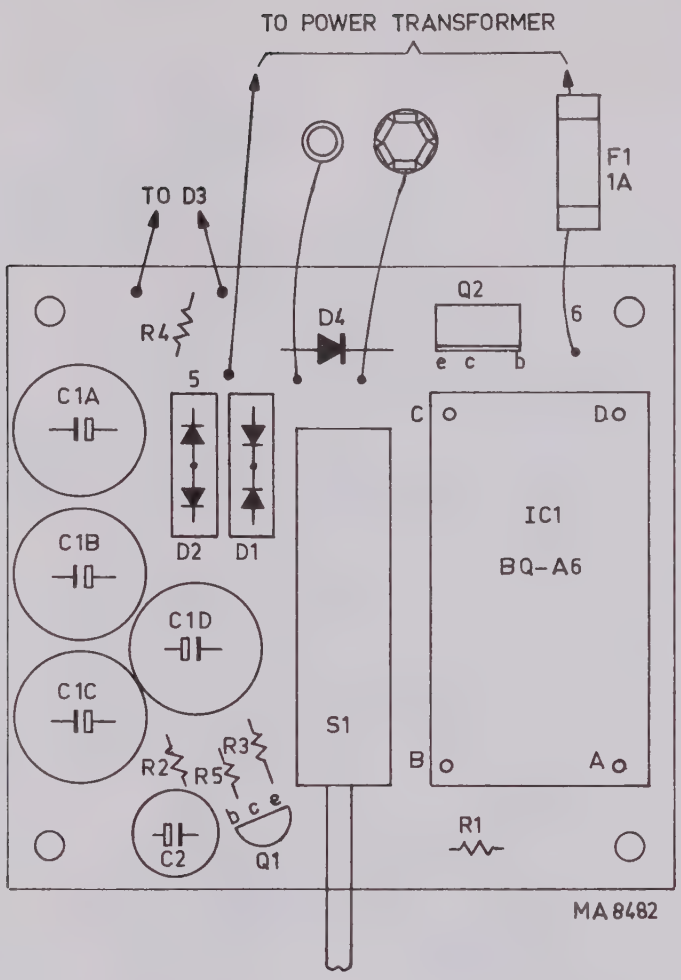


Fig. 9.13. A.C. power supply PM 9398 p.c. board

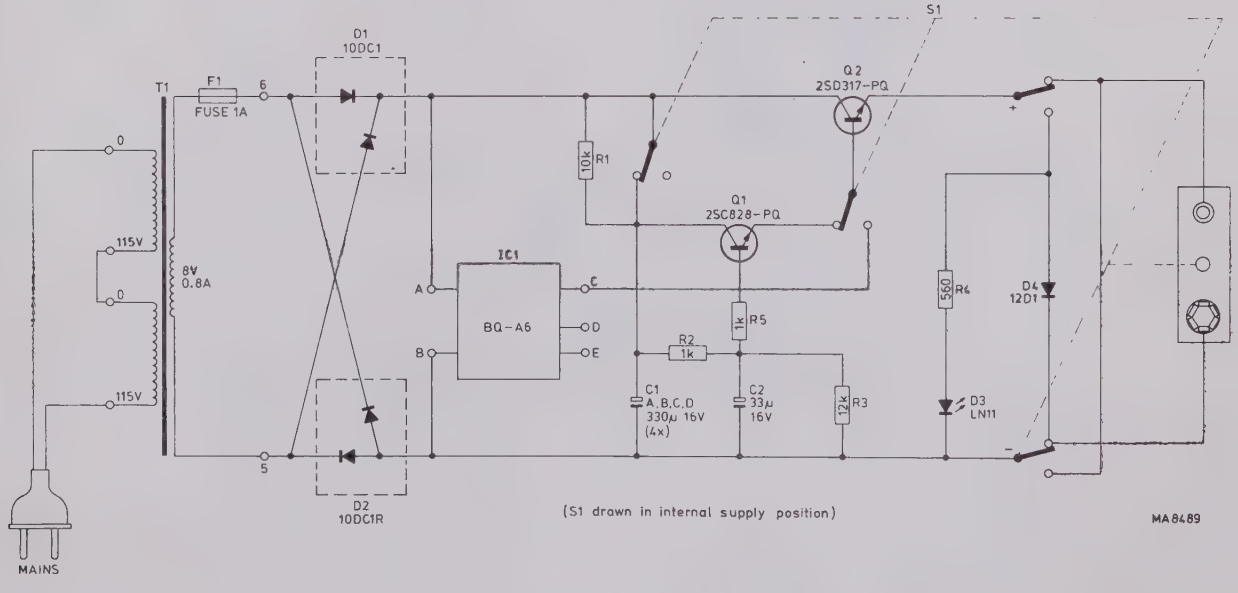


Fig. 9.14. Circuit diagram a.c. power supply PM 9398

QUALITY REPORTING

CODING SYSTEM FOR FAILURE DESCRIPTION

The following information is meant for Philips service workshops only and serves as a guide for exact reporting of service repairs and maintenance routines on the workshop charts.
For full details reference is made to Information G1 (Introduction) and Information Cd 689 (Specific information for Test and Measuring Instruments).

LOCATION

□□□□

Unit number
e.g. 000A or 0001 (for unit A or 1; **not 00UA or 00U1)**

or: Type number of an accessory (only if delivered with the equipment)
e.g. 9051 or 9532 (for PM 9051 or PM 9532)

or: Unknown/Not applicable
0000

COMPONENT/SEQUENCE NUMBER

□□□□□

Enter the identification **as used in the circuit diagram**, e.g.:

GR1003	Diode GR1003
TS0023	Transistor TS23
IC0101	Integrated circuit IC101
R0....	Resistor, potentiometer
C0....	Capacitor, variable capacitor
B0....	Tube, valve
LA....	Lamp
VL....	Fuse
SK....	Switch
BU....	Connector, socket, terminal
T0....	Transformer
L0....	Coil
X0....	Crystal
CB....	Circuit block
RE....	Relay
BA....	Battery
TR....	Chopper

CATEGORY

□

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

Parts not identified in the circuit diagram:

990000	Unknown/Not applicable
990001	Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002	Knob (incl. dial knob, cap, etc.)
990003	Probe (only if attached to instrument)
990004	Leads and associated plugs
990005	Holder (valve, transistor, fuse, board, etc.)
990006	Complete unit (p.w. board, h.t. unit, etc.)
990007	Accessory (only those without type number)
990008	Documentation (manual, supplement, etc.)
990009	Foreign object
990099	Miscellaneous

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